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Proceedings: NATO CCMS Seminar Blue Book 159,

Preservation of Flora and Fauna in Military Training Areas

This document provides proceedings of the seminar on the Preservation of Flora and Fauna in Military Training Areas, held in Soesterberg, The Netherlands, from 28 to 30 November, 1984. The seminar was sponsored by the North Atlantic Treaty Organization's (NATO) Committee on Challenges of Modern Society. Fifteen presentations were given on topics such as the effects of military training on soil, vegetation, birds, and mammals, and the various programs being used by NATO countries to help preserve and conserve these resources.

The objectives of this document are to (1) disseminate the results of this seminar to U.S. Army installation offices and headquarters responsible for managing Army training lands and (2) provide a permanent documentation of the seminar proceedings that can be used by NATO members. These proceedings provide valuable and innovative insight about how other countries are handling the environmental problems associated with military training. They also represent a step in the process toward developing systems and guidelines to help U. S. Army installation land managers conserve the natual resources for which they are responsible, while still providing a more realistic training area.

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Keywords: ecology, environmental management

FOREWORD

These proceedings were printed for the Office of the Assistant Chief of Engineers (OACE) by the Environmental Division (EN) of the U. S. Army Construction Engineering Research Laboratory (USA-CERL). The work was performed under Project 4A162720A896, "Environmental Quality Technology"; Task A, "Installation Environmental Management Strategy"; Work Unit 030, "Guild-Based Training Area Maintenance." The OACE Technical Monitors were Mr. Donald Bandel, DAEN-ZCF-B, and COL T. H. Magness, DAEN-ZCE.

The conference was hosted and the proceedings coordinated by John A. S. Walker, Deputy Assistant Secretary General for Scientific Affairs, North Atlantic Treaty Organization, Scientific Affairs Division, Brussels, and by Air Commodore F. P. Schulte, 8-34 Soutelandelaan, 2597 EZ's-Gravenhage, The Netherlands.

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Dr. R. K. Jain is Chief of USA-CERL-EN. COL Norman C. Hintz is Commander and Director of USA-CERL, and Dr. L. R. Shaffer is Technical Director.

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CHAIRMAN'S REMARKS

John A.S. WALKER
Deputy Assistant Secretary General
Scientific Affairs Division, NATO

A seminar on The Preservation of Flora and Fauna in Military Training Areas was held at Soesterberg, The Netherlands, from 28th to 30th November, 1984 under the auspices of the NATO Committee on the Challenges of Modern Society (CCMS).

60 participants, representing 9 countries, attended the seminar which was aimed at bringing together managers and researchers active in this field in order to exchange approaches, ideas and experiences.

15 formal presentations were made, covering a large variety of different types of terrain, vegetation and clientèle (furred an feathered). The reader will be struck both by the complexities of the problems encountered and the success achieved by a small group of people whose dedication and enthusiasm are reflected by these representative presentations.

That our animals and birds find some of their safest havens within our military training areas - including firing ranges - may surprise some. Yet the fact remains that they not only flourish but even include, within their habitats, the few remaining representatives of several endangered species. And this phenomenon is also extended to the flora in many training areas where well conceived and executed land conservation policies have been rewarded by the reappearance of plants and other flowers not identified for many a long year.

The presentations made were designed for the expert participants of the seminar. However, their intrinsic value to others not able to attend was considered worth the preparation of a publication - albeit with modest resources.

Furthermore, it is hoped that the information it contains will be of interest to the wider public represented by those many citizens concerned with the conservation of their wildlife and nature heritage. There can be few more striking examples of a field of activity which provides advantages to all those concerned - the soldier whose training under realistic natural conditions is maintained in spite of heavy usage, the citizen, parts of whose country are maintained in their original beauty and, not least, that multitude of non-voting "citizens" who are offered environments secure from the ever-increasing encroachments of mankind.

As chairman of the seminar I would like to thank, on behalf of all participants, the Defence Department of the Netherlands, and particularly the Director of Materiel (Infrastructure), for its efficient organization and warm hospitality so freely given. Our thanks also go to those whose presentations, offered in this binder, made the seminar the success it undoubtedly was.

NATIONAL EXPERIENCES ON THE PRESERVATION
OF FLORA AND FAUNA IN MILITARY TRAINING AREAS

T. Schaldemose-Nielsen,
Asst. Head of Department,
Ministry of Defence, Denmark

BACKGROUND. MILITARY RULES CONCERNING CARE OF GAME.

The Danish legislation covering the whole environmental sphere includes of course all areas administrated by the Defence. But it has been found necessary to elaborate more detailed regulations related to the care of game - let me call them "Standard Procedures". This said I must admit that it has not yet been found necessary to publish regulations concerning protection of the flora - here the legislation only governs the protection. And now some comments on care of game.

The basis is quite clear as all areas belonging to the Armed Forces shall manifest itself as a refuge for the fauna of Denmark. This means the fauna as a whole and not just chaseable game. Consequently chase as such may only be practicable, if the sporting utilization can be combined with the primary purpose of such areas - it might be firing ranges, training areas or air bases. Furthermore chasing is only allowed to serve the care of game. Thirdly it is prohibited to make any leasing of hunting rights, and forthly predatory animal may be pursued, whenever needed, which means if an official order indicates the necessity of such an extermination. Normally such animals are only to be exterminated as part of - let us call it - a normal reduction.

This said there is a most important exception especially as to air-bases, where preventive measures, in order to diminish the danger of collision between aircraft and birds/game, allow hunting to the greatest possible extent, but still with due respect to the local care of game and bird.

And who is responsible for the compliance with these rules - the local commandant. He will always be an officer (major/lieutenant colonel) with the administrative responsibility of a garrison, a camp, a depot or an air/naval base.

What is the responsibility of a local commander? Except for his administrative duties

- he is the supervisor of the stock of game, which means among others that he has to keep up the stock and to promote a healthy and many-sided stock,

- he has to secure and create the best possible conditions of life for game and birds,
- he alone is responsible for keeping of the Game Act and related regulations and
- last, but not least he alone is responsible for management of money intended to promote the care of game.

But from where will these money emerge? As already mentioned hunting is not forbidden, but all types of animal and bird have to be sold via the commandant, and the prices are governmental fixed, as we have to follow the price regulations as laid down by the forest authorities. Of course there is a reason behind that, as the hunter hereby is reserved the right to buy his own bag for personal use which is close in accordance with the regulations applying to everyone from the forestry authorities. If this preference is not used, the animal or the bird has to be handed over to a poulterer and now the price will be commensurable with that of a grocer's.

The revenue from this activity is of course not overwhelming - some hundred thousands Danish kroner yearly, but they serve their purpose as part of the system. These money are so to speak tied up. It means that the revenue according to the procedures shall be used to care of game, i.e. to new plantation (trees or/and flowers), stocking of animals or birds, construction of artificial dens, procurement of traps and so on.

As you may understand all these procedures need a combined administration and to that purpose we have a special function named "The Game-Keeper to the Ministry of Defence". His job is to supervise all the commandants and consult in all game-matters He is also the link between the Defence and the Institute of Game-Biology, which belongs under the Ministry of Agriculture.

As for the game-keeper, normally an elderly colonel, we always choose an active hunter, but as not every Danish officer presumably is a hunter the local commandant is allowed to nominate a member of his staff-element as "game-officer".

THE AREAS OF THE DEFENCE. THE DEFENCE AS LANDOWNER.

Denmark as a united kingdom was established more than thousand years ago and since then defence has called for mili-

tary installations to the development of the military technology. This development has called for new and more specified areal demands. We are not just defending the towns as such, but on the other hand you could formerly regard the open country as one large training-area. To-day the situation is quite opposite.

One per cent of the whole Danish area, it means 36.000 ha, is administrated by the Defence, the majority of which has been acquired within the last 100 years. In practice these areas are cathegorized as follows:

- barracks, depots and workshops,
- air and naval bases,
- drill grounds with firing ranges and
- training areas.

Before going into details you should remember that Denmark as such is a low-lying country just as the Netherlands. We have no real heights, and the highest point is round about 140 m, and except for the island of Bornholm there are no stone cliffs. The climate is coastal and there are very few species of beast and bird of prey. Most of the land side is cultivated for agricultural or forest utilization. The dominant tree is the beech, but areas of coniferous trees are to be seen especially in Jutland adjacent to moorland. Generally speaking the country-side of Denmark is not in any way characterized by great movements as to nature. But now to some specific cases, which might give you an idea of the situation in Denmark.

WEST AMAGER.

By way of introduction I must admit that my first example is not quite new to those of you who attended the Munich Seminar in September, and let us look at an area which might be not quite unknown to you arriving by air to Copenhagen. The international airport is placed on an island East of Zealand, named Amager. Being in the Netherlands let me just tell you that centuries ago the island by the king was handed over to Dutch farmers and they started up gardening, which still is to be seen. On special occasions the descendants will wear their traditional costumes. As a matter of fact they might be the first example of guest-workers in Denmark.

The South-Western part of this island has for decades

been a military training area with quite a large firing range for not only rifles, but even mortars and artillery. On second thoughts I am surprised as all these activities were first started in 1957 and were continued for more than 20 years as the distance from the City Hall square to the main-entrance is less than 5 miles or rather was.

The area amounts to 2.800 ha. and consists in general of dammed sea bed started in 1939. As to the flora the area is quite unique, not to speak of its impact on ornithology with three predominant features:

- coast birds such as sea-gulls, terns or sea-swallows and eiders (to which I will return), and these species have here created their colonies, where they are breeding and sitting on their eggs,
- nearly all (Danish) species of wading birds are to be seen,
- the area is the most important lay-by for birds of prey in autumn and in winter, and of course
- many, many other small birds.

Why, and the answer is quite simple. Here the birds have just what they want, and there are nearly no people to disturb their way of life. The shooting and the military traffic means nothing to them. And the same goes for the vegetation, which is sparse, but also includes less well-known types.

Now we are facing quite a new situation, as it has been resolved by law to stop the military use. The Ministry of the Environment is now responsible for the area, but removal of ammunition and explosives, in fact unexploded bombs and shells lies with the Ministry of Defence and calls for manpower and special equipment.

To make a long story short the whole area will in principle be opened for the public next year, and since this spring there has been unrestricted access to everyone, provided that they will follow the tracks and comply with some restrictions. To my knowledge we have been spared of any kind of incidents and accidents, but the area as such is not attractive to every age group and e.g. you are not and will not in future be allowed to use it as bathing-place, and why that - so close to

the Sound? To save the birds and this unique bird life. I have only one question. What will happen in future? Will the birds be able to be accustomed with people walking around often accompanied by dogs and childrens playing? I wonder, but of course I do hope for the best.

OKSBØL-BORRIS.

To-day we have to our military disposal in all 10 training areas, and now I will turn to the peninsula of Jutland to our largest area comprising about 14.000 ha., which is more than a third of all the military areas.

This area is a combination of dunes, heather and pine forest, but the vegetation as such is rather sparse. As to the ornithology the whole area is very abundant with many species of especially ducks and even wading birds due to the marine foreland, the marsh and the shallow lakes. In spring and in autumn hundred of thousands of birds of passage use the area as their favourite lay-by. Although this area is extensively used, now and then even by foreign troops, it is without any problem to animals as well as to birds. This said, the problem with the vegetation is rather complicated. The military use has changed the surface as time goes on, and the vegetation is the object of attrition resulting in wide-spread sandy plains. Besides, the use of shells often causes fire, which again is an advantage for a broader extension of the heather, which is not the best to the rest of the few flowers, mainly weeds. To face this problem or rather solve it, the Institute of Botany under the University of Århus has made a widespread examination, not of this area, but a smaller infantry training area, Borris, which to some extent has the same composition except for the marineland. The results of this I cannot produce as the work was only finished a few weeks ago, but maybe we have to work out some standard procedures corresponding to those covering the care of game.

Then we are back to animals, and these areas in Jutland as most of the other training areas are real a dream of the hunter. Only few species such as fallow deer, roe deer, red deer, fox and hare are represented, but there are plenty of them due to the military care of game. And besides they are not the slightest affected by the noise from artillery, tanks or cars. I

will not assert that they enjoy their special situation, but in 1957-60 I was an instructor of heavy machine-guns at the Sergeants-School of Infantry. The training system resulted in exercises every third month in a training area on Zealand with deer and sheep, and their ability to avoid dangerous areas with targets and fire zones was phantastic. At the same time there was even training with mortars and recoilless guns, but I have never seen or been told that an animal has been hit. Quite recently this fact has been confirmed by experts when discussing my briefing to-day. On the other hand I was informed by the same people that cross-country running, not to speak of jogging is a severe problem especially to deer, in fact a stress factor has been demonstrated through sofisticated methods - their daily routine has been broken. Often the running takes place in the morning or in the late afternoon and the animals simply dislike it

GREENLAND.

As you know Greenland is the largest island of the world, but still part of the Kingdom of Denmark and just to give you an impression of the area it is 50 times as large of that of Denmark with its 2.2 mio. km^2 of which the ice cap covers more than 1.8 mio. km^2. But how does Greenland fit into my briefing? North- and Northeast-Greenland has by the law of 1974 the status of national park covering round about 10 times as much as Denmark and the responsibility for the whole area lies with the Defence. In principle the area is uninhabited except from teams on a weather station (Danmarkshavn), and an air strip (Mestersvig) plus a smaller detachment at Station Nord - all in all 35 persons But to demonstrate our sovereignty over this area and to control the situation of the animal and fish we have organized special sledge patrols, named SIRIUS, the dog star. These people, all non-commissioned officers with a very special training, by the way given in North-Norway, are on patrol for two years. I will not go into details, but yearly they, two and two + 11 dogs, do not less than 20.000 km. As to the dogs they are in active service five to six years, which means that one dog in these years has covered the distance from Copenhagen to Cape Town and back again. But, believe it or not, the Preservation Act is so restrictive that our men on patrol in principle are not allowed

hunting, except in self-defence, and do remember that the polar bear and the musk ox are very aggressive. That is another and quite different example of game-keeping.

SUMMARY.

Let me conclude in the following way: It seems quite obviously that the Danish Defence for many years has done a good job as to secure the fauna on its areas, but the flora seems to present some problems, but as already mentioned the experts have done their job, which might result in new standard procedures matching the care of game.

Thank you Mr. Chairman.

AN EXAMINATION OF THE EFFECTS OF MILITARY EXERCISES ON SOIL, VEGETATION AND FAUNA

T. Zwart, Ministry of Defence
F.C. Zuidema, National Council for Agricultural Research
The Netherlands

MINISTRY OF DEFENCE

DIRECTORATE OF MATERIEL (INFRASTRUCTURE)

SEMINAR ON THE PRESERVATION OF FLORA AND FAUNA IN MILITARY TRAINING AREAS

INTRODUCTION

1. An examination of the effects of military exercises on soil, vegetation and fauna.

MINISTRY OF DEFENCE LAND-USE POLICY

2. The objective of the MOD's land-use policy is laid down in the recently produced Structure Plan for Military Land. It is as follows:

> "The creation of land-use conditions for the effective execution by the armed forces of their tasks arising from defence policy"

Within the framework of overall government policy, MOD land-use policy is aimed inter alia at contributing to:

- the functional and harmonious development of land utilization;
- the preservation and development of the quality of the environment;
- the promotion of a desirable socio-cultural and economic development;
- restricting demands on government financial resources.

The objective to which I have referred is also elaborated in a number of guidelines in the Structure Plan. In this presentation I shall refer to the most relevant ones.

- adequate facilities must be available in order to achieve and maintain the necessary degree of proficiency and to maintain the capacity of the armed forces for operational deployment;

- cooperation will be provided in regard to the multiple use of military land if the activities involved are compatible;

- in the location and use of military training areas the aim is that as few adverse consequences as possible occur in regard to recreation, agriculture, housing and other civil interests. The importance of maintaining existing natural communities will also be taken into account.

This brings me to the essence of this address. With the adjustment and adaptation required in the organization of military training areas in the rural areas, the Defence Ministry often comes up against the interests of nature preservation. In former times there were no reasons for conflict. After all, in those days the army consisted mainly of foot-soldiers and horse. However, with the advancing mechanisation of the Royal Netherlands Army, a change took place. Moreover, there is the additional fact that people nowadays pay more attention to nature and to its importance. Besides, recreationists make great demands on nature. Hence the essentials of the conflict can be reduced to the fact that the interests of defence, recreation and the preservation of nature lie for the greater part in the same parts of the rural areas. NOD takes the view that, if the political will is there, these three can often go hand in hand.

POLICY QUESTIONS

3. In order to address the reasons for this conflict and to enable solutions to be found to them, it proved desirable and necessary to undertake a scientific examination of the effects of military land-usage on flora and fauna. On the basis of these policy questions the MOD Directorate of Materiel (infrastucture), whose responsibilities include the laying out and maintenance of military training areas (i.e. the real estate), joined the National Council for Agricultural Research (NCAR) as a participating member. I should just like to mention at this stage some of the advantages of this participation:

- the NCAR gathers together the researchers to carry out the examination and makes arrangements with the authority commissioning the work - in this case MOD -to steer it along the right lines and within the financial limitations set down.

- it was possible to make use of a wide range of experts from various institutes to deal with the apparently complex questions raised by Defence. A single wheel tester to check the performance of the tyres on vehicles has proved to be useful for experimental tests with military vehicles.

THE REQUEST FOR AN EXAMINATION COVERED THE FOLLOWING ASPECTS

4.

a. The effect of military exercises on flora and fauna.

- what is the present-day composition of the flora and the large species of fauna on the military training areas (including those on heathland);

- what is the composition of flora and large species of fauna on comparable heathlands that are not military training areas;

- what are the differences between them and can these be wholly imputed to military use;

- are these differences adverse (i.e. does impoverishment occur) or are they of the same level (i.e. there is only a change but no impoverishment);

- what are the short-term and long-term consequences for the flora of driving through heath vegetation once and more than once;

- what is the effect on flora of various types of vehicle being driven through heath vegetation.

b. Report on Environmental Effects.

- what is the effect on the soil of constructing a system of tracks (i.e. by digging);

- what is the influence on flora, fauna and soil of laying out a new training area and putting it into use;

- how do the disused tracks develop as regards soil and flora (see also d);

- what effects does the digging of tracks have on the vegetation that exists alongside the tracks;

c. Consequences of the re-laying out of areas of drift sand.

- what are the consequences for the character (i.e. flora and fauna) of an area of drift sand of constructing sand tracks suitable for wheeled vehicles;

- what are the consequences for the character (i.e. flora and fauna) of an area of drift sand of using tracked vehicles on it;

d. Evaluation of plant growth on disused tracks and restored areas and areas no longer wooded.

- what is the sequence of vegetation (plant types) that develops on disused tracks and areas that are no longer wooded;

- does the desired growth (heather) eventually take place;

- is the present-day sowing with sheep's fescue the best way of bringing about eventual growth;

- is the sowing of heather more effective;

- is the right preparation of the soil being carried out near the tracks no longer to be used.

Finding the answers to all these questions would require extensive research work and funding of a similar order. It was therefore decided to restrict the work to the most important effects on heathlands, the most frequently occurring type of land. In addition, a plan was designed for the phasing of the various subsidiary studies within a total programme period of 5 years (1980-1984). During the course of the research it was apparent that the MOD was not the only authority that had a requirement for a study of this kind. In the area of nature conservation too there was interest in this type of study (in connection with, for instance, the relationship between recreation and the preservation of nature). This was evident from the time devoted to the examination by the participating institutes and their research workers - which in financial terms - far exceeded the sum set aside by Defence (about 1 million guilders spread over 5 years). The three institutes carrying out the study are putting a great deal of their own time into it.

I want to express my appreciation to these three institutes: the Soil Survey Institute, the Institute of Agricultural Engineering and especially the Research Institute for Nature Management which, comparatively, has devoted an extraordinary amount of effort to this study.

BRIEF OUTLINE OF THE STUDIES

5. The aim of the examination may be summarized briefly by the following questions:

- What is the effect on the soil, vegetation and fauna of the measures taken in laying out the training areas and of military exercises, and how must these effects be judged in the light of the objectives of nature conservation?

- How are the interests of nature conservation best served within the framework of a multifunctional use of military training areas? (This also includes the removal of roads no longer required.)

The answers to both questions are concerned with determining the effects.

This applies both to the user, who can lay out, manage and use the areas in different ways, and to the environment which will react in various ways to this "intervention by the military". Firstly, therefore, a general description was made of the activities that take place in military training areas and at the same time an inventory was prepared of the nature of the soil, the vegetation, large species of fauna and the cultural history of all military ranges. This preliminary study and a literature study of the bottlenecks in the relation "ship between military exercises" and the importance of the natural environment constituted the basis for the selection of the problems to be covered by the examination and of the areas where field-studies could be carried out. The final choice covered 4 subject areas:

a. lay-out and excavation, sub-divided into:

(1) demand for space and pattern of lay-out of facilities;

(2) hydrological consequences of the construction of sand tracks;

(3) isolation effects of sand tracks and roads.

b. the presence of people and equipment in connection with breeding birds;

c. driving and walking over the terrain;

d. establishing vegetation on those parts of the terrain that are no longer used or that have been excavated, with the following sub-divisions:

(1) sensitivity of land types to erosion;

(2) germination and establishment of plant types i.e. vegetation.

The examination covers both bureau studies and field studies. The latter are especially of a comparative and corrective kind. This means that existing situations, in which differences occur in the intensity of military use, are compared with one another. Sometimes air photographs have made it possible to follow changes in the vegetation over several decades as a result of the increased use of vehicles. Similar tendencies are also very important in the other direction for example where disused tracks gradually become less discernible in the landscape and assume the same natural characteristics as those occuring in the vicinity.

Considerable significance is attached to the synthesis between the various subsidiary studies. Since the programme was set up, much attention has continued to be given to conesion in the examination of effects. This is not only a matter of interest from the scientific point of view, but, in the preparation of the plans for the lay-out and management of military training areas, the conclusions that can be drawn from a synthesis of this kind are also of practical value. This applies in particular to the subject of driving and walking over the terrain which is based both on experiments and on a scientific understanding of the various disciplines involved. The study concerning disused tracks and that relating to the claim on space are also characterized by the syntheses they present.

The examination has now reached the last phase, namely that of synthesis and conclusions. A number of these will be presented to you in the addresses that follow. I should like to conclude our general presentation with two observations:

a. During the period of the examination both the Ministry of Defence and the research institutes have imposed restrictions on themselves in the interests of achieving adequate quality in the implementation of the examination. By this I mean that we deliberately omitted from the study a number of soil types, such as marine sandy soils owing to their different situation (i.e. militarily, pedologically and hydrologically). In addition, a number of specific questions have arisen in recent years which could no longer be broached during the period of the examination because of the constraints imposed by both time and budget;

b. Cooperation of this kind between the Ministry of Defence on the one hand and a group of research institutes on the other could also be fruitful in the future, when, for example, certain political decisions will have to be based on reports relating to the effects on the environment.

This concludes the introduction to the Dutch contribution to this seminar. I shall now ask the other Dutch speakers to take over.

EFFECTS OF OFF-ROAD LOCOMOTION ON SOIL 'EGETATION IN HEATHLAND

by H. M. Beije

1. INTRODUCTION

The Netherlands has some 45,000 ha inland heathlands and shifting sands. The actual heathlands are remains of a much bigger area of heathland in which the Netherlands formed the centre. Inland shifting sands are the result of overusing heathlands in former ages. Holland is the only country in Western Europe where some large-scale shifting sands of this type still exist.
13,500 ha of heathland and shifting sands is used now for military purposes. The government intends to protect all heathlands and shifting sands for nature conservation and recreation, also in military training areas.

Because of mechanization and adaptation of operational tactics, the structure and use of training areas is changing.
The surface of free-for-all areas will be enlarged from 1000 to some 2800 ha. In the remaining areas (± 10,000 ha), military vehicles are dictated to go only by roads. Nevertheless research on off-road locomotion has been started to provide scientific information why vehicles should drive whether on roads or off roads.
In 1981 the Dutch Ministry of Defence charged to investigate the effects of off-road locomotion on the soil and vegetation. This research will be ended in 1985. In this briefing some preliminary results are given.

2. DESIGN OF RESEARCH ON OFF-ROAD LOCOMOTION

In general the soil in Dutch heathlands is sandy (150 - 500 μm) with some 0 - 25% loam. The ground water level mostly does not affect vegetation, but in some thousands of hectares of military area it does. The podzolized soils vary from gleyic podzols (Typic Haplaquod) to humic podzols (Typic Haplohumod) and leptic podzols (Entic Haplorthod).
The heath vegetation is mostly dominated by Calluna vulgaris and/or Erica tetralix. The species composition as a rule is rather poor.

From general literature is known that off-road locomotion at short notice may cause soil compaction (water stagnation included) and transformation of soil layers. The vegetation may be mechanically damaged. At long notice soil deformation may result into alteration of various soil characteristics: air, water and nutrient content, pH and infiltration rate. In consequence, the species composition and/or the vegetation structure may change. On aerial photographs narrow grass strips amidst heathland indicate that former trails can have a different vegetation indeed.

In several ways investigations can be set up, studying effects of off-road-locomotion:

- comparison of situations before/after off-road locomotion. However no such situations were available with detailed information about time, vehicles, frequency of passing, wheather, etc. during the performance.
- comparison of areas with/without off-road locomotion. Two suitable situations were available to study. Some data will be given below, dealing with effects at long notice.
- experiments. Situations in/outside trails can be compared as well as situations before/after interference. Within the period of our study, only short-term effects are focussed. This briefing intends especially to describe some experiments.

3. *SOME RESULTS COMPARING AREAS WITH/WITHOUT OFF-ROAD LOCOMOTION*

Three situations have been studied:

- EDDELER BUURTVELD

  This area has been used in 1963 for some days practising Centurion tanks. In a small part of the area, namely on loose brown forest soils, tracks (5 - 15 cm deep) can still be seen.
  In 1982 indications were obtained that the vegetation inside the tracks differs from outside. Soil compaction was established till at least 70 cm below the surface (figure 1). pH and nutrient content seem to have changed also.

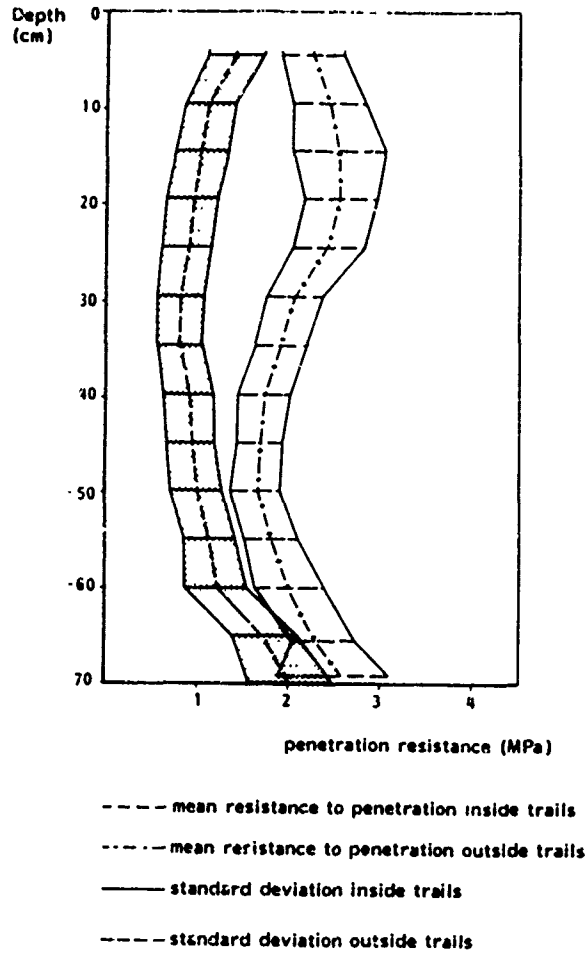

Figure 1 Penetration resistance curves (incl. standard deviation) in/outside Centurion tank trails (one pass) in the Uddeler Buurtveld area. The soil is a loose brown forest soil (Entic Haplorthod)

- ARNHEMSE HEI

In this area (high heather podzol soils) two vehicles (AMX-tank and YP-408 personnel carrier) had been tested in 1972 by the Ministry of Defence, to study the direct effects on the vegetation. Frequencies of 1, 5 and 10 passes were applied.

In 1982, the heather in the trails of both vehicles (5 or 10 passes) was dead, but no alteration of pH or nutrient content was assessed.

- STAKENBERGER HEIDE

In the Fifties and early Sixties this heathland area was free used by heavy military vehicles.

After 1963 only roads were used. In 1983, this area was compared with an adjacent heathland, not used by vehicles.

In the first area, soil compaction and alteration of the vegetation were noticed (figure 2). On the basis of a few measurements indications were obtained that the pH has changed also. Alterations are relatively most obvious in podzol sites covered with shifting sand. Areas that were bare in 1963 hardly have the original vegetation types.

In view of the results of these studies, experiments were justified.

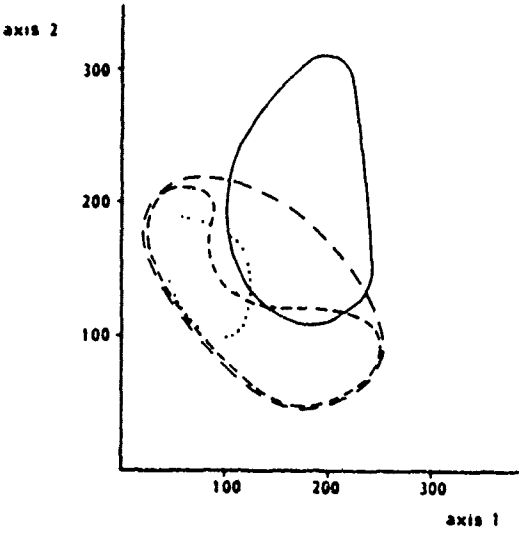

Figure 2 Plot of the scores on axis 1 and 2 of DECORANA correspondence-analysis of heath vegetation types in the Stakenberger area in 1983, showing the position of the clusters along the two main environmental gradients. Each cluster represents vegetation types from different intensities of off-road locomotion and different soil types. The off-road locomotion stopped in 1963

4. EXPERIMENTS

Factors taken into analysis are:

- on military training: wheel/tracked vehicle, weight, pressure and width of tyres, frequency of passing, percentage of slip, season
- on the object : soil type, vegetation type, age of heather.

The following scheme shows how these factors have been combined in the experiments. The main distinctive factors are 4 different soil types, applications of full scale vehicles as well as wheel testers, 2 different types of pneumatic tyres, 2 different tensions of the tyres and 3 different frequencies of passes.

	wheel tester						full scale vehicles						trampling per month		
	iron wheel		12 R-20		18 R-22.5		YA 1440			leopard-1					
	1600 kg	2400 kg	2 bar	7 bar	1.5 bar	7 bar	1x	3x	9x	1x	3x	9x	1x	5x	16x
brown forest soil															
spring	•	•	•	•	•	•	•	•	•	•	•	•			
summer	•	•	•	•	•	•	•	•	•	•	•	•			
high heather podzol															
spring	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
wet heather podzol															
spring	•	•	•	•	•	•									
xero vague soil															
summer	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•

Tabel 1 Trial scheme for the experiments on off-road locomotion

Reasons to apply wheel testers are:

- precise administration of weight, speed, percentage of slip etc.
- measuring the rolling resistance that possibly is related to soil and vegetation properties.

The experiments have been executed in 1982. Since then, observations were made on soil (soil compaction, sinkage, chemical analysis, density of roots), on vegetation (mechanical damage and regeneration, species composition, total biomass, length of branches, number of seedlings) and on the wheel tester (rolling resistance).
These measurements are helpful to quantify differences between different interferences. The observations are being finished by now and have only been analyzed partially.

Summarizing interim results from all our investigations on off-road locomotion, the following conclusions can be made:

- In loose soils and under wet conditions off-road locomotion results in soil compaction and alteration of the vegetation
- These alterations may last (much) longer than 20 years
- Soil characteristics like pH and C/N ratio may change also, but about causes is little known
- Soil types like high heather podzols are less vulnerable
- One pass sometimes results in a looser soil, in spite of deep tracks. Explanation is not yet available
- Mechanical damage on plants regenerates within some years; alteration in species composition may start after some years.

5. EFFECTS AND POLITICS

The effects as mentioned before will be translated in recommendations. This has to be done in different steps.
First of all the effects of off-road locomotion should be discussed in relation to other effects of military training activities, not only on soil characteristics and vegetation but also on geomorphology, hydrology, archeology and fauna.
For instance, the effects of off-road locomotion will be compared with those of road construction. Road construction can affect a.o. hydrological field properties and isolation of animal populations.

The next step is the evaluation of effects in view of the aims of nature conservation, like rareness, authenticity, diversity, etc. In this context it is important to delimit the area and location of the different functions of heathland. Also methods of reaching the relevant goals will be discussed.

The last step is making recommendations for structure, use and management of military training areas.
Just like in the preceding step, scientists should provide information about effects and about possible choices and their consequences. This information is indispensable for political decision-making.

The final results of the study will be presented to the Dutch Ministry of Defence. They may be regarded as a direct advice to politicians and projectors.
Besides, the results will be published in order to inform everyone who is involved in nature conservancy, e.g. for Environmental Impact Statements.

Since decisions on national level are being made on this moment, no important consequences are expected about area, location and global structure of military areas.
On local level, however, structure, use, and management of military areas may be adapted to nature conservancy purposes.

STUDIES ON THE EFFECTS OF MILITARY ACTIVITIES ON SHORE-BIRDS IN THE WADDEN SEA

by C. J. Smit & G. J. M. Visser

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The Netherlands

SUMMARY

The Wadden Sea is Europe's most important wetland. The Dutch part of it comprises about 240,000 ha, of which 120,000 ha consist of tidal flats offering food for several millions of migratory birds. Some of these may spend only a few days in the area, others several months. They may use the area as a short feeding site, moulting place, wintering area or as an area to stay somewhat longer to lay down fat reserves to facilitate long migratory flights towards breeding or wintering areas. There are indications that feeding conditions in the Wadden Sea partly determine their breeding success elsewhere.

This paper reviews present military activities in the Dutch part of the Wadden Sea. Attempts are made to point out possible conflicting situations between nature conservation interests and military activities. The first results of a study on the effects of all kinds of disturbance (including those caused by military activities), carried out by the authors, are given. Disturbance may have short term and long term effects, theoretically ranging from occasional flying up of birds to permanent shortage of food having effects on a population level. First results of a study on the effects of training flights of military aircrafts at the Noordsvaarder shooting range at Terschelling, show that roosting Bar-tailed Godwits (Limosa lapponica) and Curlews (Numenius arquata) may loose up to 3% of their daily energy need, due to all kinds of disturbance during high tide, outdoor recreation and military training flights being the most important causes. The implications of this loss are subject of a long term study on the effects of disturbance on food uptake and condition of shore-birds, the results of which will become available in the following years.

1. THE WADDEN SEA AND ITS FUNCTION TO BIRDS

During low tide the Wadden Sea is characterized by tidal flats and shallow water, sparated by channels which may be up to 40 m deep. It is situated along the coasts of The Netherlands, the Federal Republic of Germany and Denmark. Total size of the area is about 8000 km^2, about half of it consisting of tidal flats. The Wadden Sea is separated from the North Sea by a chain of islands, which are important as breeding places for a great variety of birds, often breeding in colonies (Smit 1981). In this paper, however, most attention will be given to non breeding birds, since the Wadden Sea may be regarded as the most important wetland for migrating birds in Europe. These birds originate from a huge breeding area, ranging from Ellesmere Island in northeast Canada in the west to Taymyr peninsula in central Siberia in the east. Most of the birds concerned are waders or shorebirds (Charadrii) and waterfowl (mainly ducks and geese) which breed in arctic and subarctic tundra habitats, though the Wadden Sea is also visited by birds from local or northwest European breeding populations. We may call this whole group of about 40 bird species shore-birds or estuarine birds.

In late summer about 3 million shore-birds are present in the whole international Wadden Sea at the same time, about 2 million of these being waders. During mid-winter numbers are smaller. By then about 1.5 million are present. Numbers increase again somewhat in spring, illustrating that, though the Wadden Sea is an important wintering site for Nearctic and Palearctic breeding birds, the area is of even greater importance during migration periods. Because in autumn and spring there is a continuous flow of birds through the area, the total number of shore-birds actually using the area, will amount to at least 6 million. Some of the species passing through the Wadden Sea migrate further south to reach wintering quarters in Africa, some of them even go as far south as South Africa (Fig. 1). This illustrates that the Wadden Sea acts as a stepping stone in a chain of wetlands along the coasts of Europe and W. Africa (the East Atlantic flyways; Fig. 2). Many of these areas are currently under threat because of a large variety of human activities, ranging from reclamation, habitat destruction and pollution to severe disturbance (Prater 1981).

Fig. 1 Migratory routes of birds using the East Atlantic flyway, showing breeding areas (hatched) and wintering areas (dotted). After Swennen (1976)

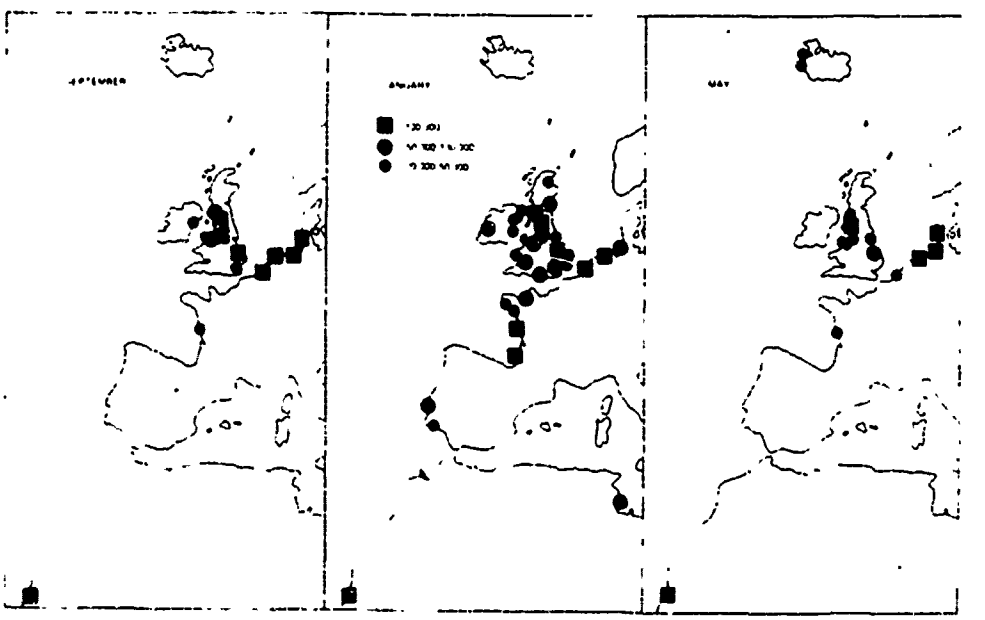

Fig. 2 Major occurrences of waders (Charadrii) in estuaries in Europe and NW Africa in September, January and May. After Prater (1981)

All wetlands along the East Atlantic flyway have specific functions for the birds using them, functions changing throughout the year. The Wadden Sea, for instance, acts as an important moulting area in late summer. During primary moult birds replace their flight feathers, as a result of which they loose part or even all flying capacities. In the German Bight in late summer over 200,000 moulting Shelduck (Tadorna tadorna) are present, which cannot fly for about 4 weeks (Goethe 1981). Moult is a much energy demanding process. Obviously the birds need areas providing sufficient rest and food during this time of the year and, apparently, the Wadden Sea is still doing so.

During midwinter shore-birds may meet great difficulties exploiting their food resources, not only because parts of the Wadden Sea may freeze but also because prey organisms become less active, are living at greater depths in the sediment and contain less energy than in summer. Birds species feeding on sight may have difficulties because of short days. Nevertheless the birds have to be able to build up and maintain energy reserves to cope with situations in which foraging is impossible for a few days or even longer.

For geese there appears to be a correlation between spring condition of birds and their reproductive success in the breeding season afterwards (Ebbinge et al. 1982). In this way feeding conditions in spring staging areas may be a factor determining breeding success, and even population levels. There are indications that this also applies to some arctic wader species (v.d. Have 1984).

The existing information on the balance between energy gain through food intake and the energetic costs of daily activities, shows that this balance is a critical one, especially in periods in which extra energy is needed (Goss-Custard 1977, Pienkowski 1982). This implies that severe disturbance of birds on the feeding site or on high tide roosts, forcing the birds to stop feeding and/or to spend extra energy, may have negative effects on their condition. Possibly it even has effects on population levels.

harbour, during 20 days per year, requiring an unsafe zone of 34,000 ha. A torpedo range in the Texelstroom channel, east of the island of Texel, has been layed out for testing equipment and adjustment of torpedos. This requires a range of 13.5 x 2 km. During the tests the torpedo, with a non-explosive charge, is followed by a helicopter. It is expected that this activity will stop in 1985. Close to Den Helder Navy airstrip De Kooy harbours a Main Operating Base for Navy helicopters. The strip is also used by civil aircrafts, contributing to 10% of the overall sound pressure.

Texel. The amphibious training camp at the Mok Bay (110 ha of water and land) is maintained by the Navy for the training of marine commandos. Activities involve operations with landing crafts and helicopters at the southern part of Texel as well as on the adjacent Wadden Sea.

Vlieland. The Army shooting range at Vlieland is used during 30 weeks per year (September 1 - April 15) and during 4-5 days per week. The range is situated at the Vliehors, the extensive sandflat at the western part of the island. It is used to exercise with tank artillery at stationary and movable targets. The unsafe zone, extending mainly over the Wadden Sea, covers about 10,500 ha. The target area, including the fixed shooting-point, comprises an area of about 150 ha. When people or ships are within the zone, shooting is stopped for safety reasons. In the period when no shooting takes place, because of conservation and recreational interests, maintenance activities are carried out. Close to the shooting camp an intensively used air-to-ground airforce shooting range is situated, which is used for dropping bombs and for shooting at ground targets with cannons and rockets. The range is used by the Dutch Airforce as well as by other NATO countries. It is also used for gun research. Total area of the range on the land is 335 ha, the unsafe zone amounts to 3750 ha. The range is available during weekdays all through the year. Due to weather conditions limiting flying, the actual use is on average about 180 days per year. No explosive bombs are used from March 1 - September 15. Photoflash flights at night are also permitted. Shooting is carried out in the direction of the North Sea. The restricted flying zone extends over an area of about 68,900 ha, up to an altitude of 12,500 m. Most of it is situated over the central part of the western

2. MILITARY USE OF THE WADDEN SEA

Due to the small number of people living in the Wadden Sea area, and the absence of houses in large parts of the area a great variety of military activities is undertaken. Air Force, Navy and Army are training in the area (Fig. 3). Military activities in the Dutch part of the Wadden Sea have been summarized before by Waddenzeecommissie (1974), De Roos (1983), and Coördinatiecollege Waddengebied (1983).

Present situation.

Den Helder is the base of the Royal Dutch Navy. Apart from in and out-sailing ships a shooting programme is carried out from "Schietkamp Zeefront" towards the North Sea. The high sand Razende Bol is situated in the unsafe zone. Ship artillery is tested from Den Helder harbour during 90 days per year, facing the Lutjeswaard area. Ballistic trials of long-range artillery are carried out by the Army, out of Den Helder

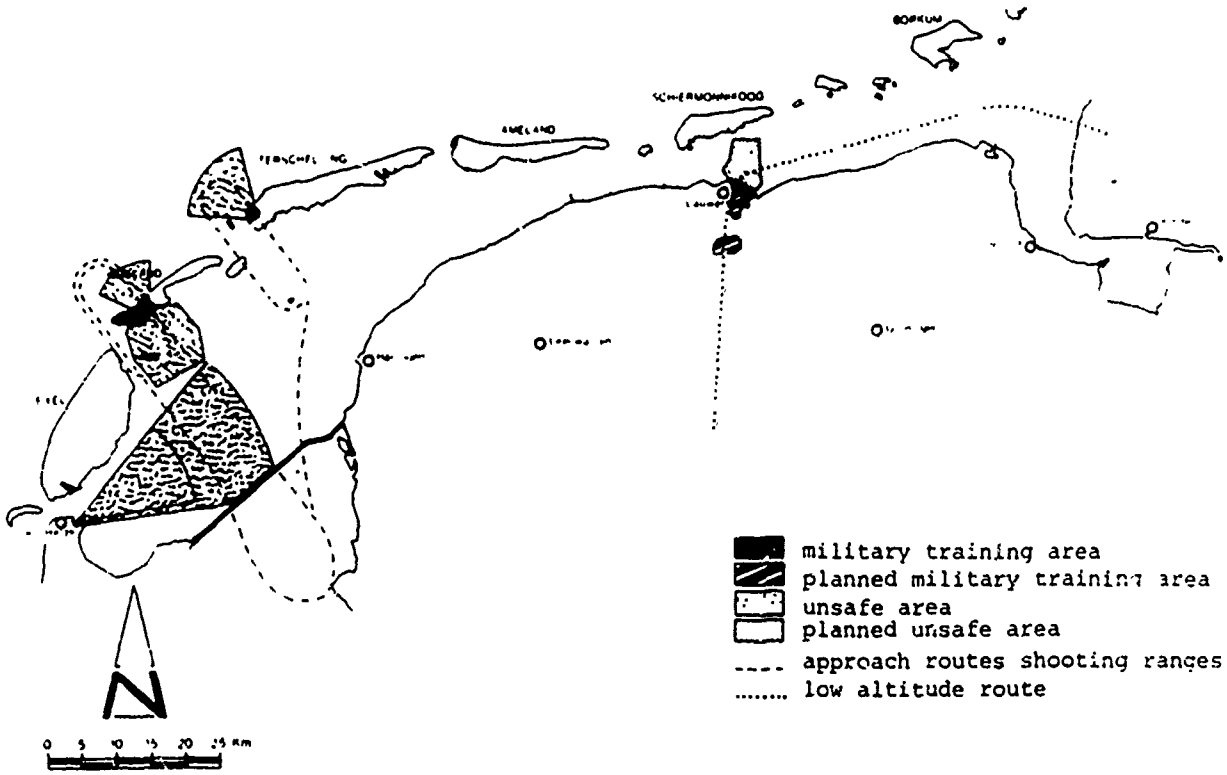

Fig. 3 Areas in the Wadden Sea where military activities take place. After Coördinatiecollege Waddengebied (1978)

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Dutch Wadden Sea, a smaller part covers the North Sea off Vlieland.

Terschelling. The airforce range is situated at the Noordvaarder and is used for air-to-ground target practice with rockets and cannons with projectiles containing non-explosive loads and for exercises in dropping of non-explosive bombs. The range occupies an area of 215 ha; on land the unsafe zone has a size of about 3,750 ha. The restricted flying zone extends over an area of about 17,663 ha, the great majority of it situated over the Wadden Sea, with a maximum altitude of 4,575 m. The training ground is available the year round. The target practices have to be interrupted repeatedly because of coastal protection activities and because ships are present in the unsafe zone. Owing to these factors, the use is only possible during 180 days per year at the most. At the Noordvaarder it is not allowed to use after-burners and the westernmost targets are preferred usually. An airforce helicopter makes daily flights across the Wadden Sea from Leeuwarden airport to Terschelling and Vlieland and vice versa, to be of assistance in case of an accident during the training flights.

Low-altitude route Uithuizumer and Groninger wad. This route, used for 6 flights per weekday on average, at a minimum altitude of 75 m, at this moment still crosses the whole eastern part of the Dutch Wadden Sea. In the near future, however, the route will be removed northward over the North Sea to cross the Wadden Sea west of the island of Schiermonnikoog.

Marnewaard. In the nearby future a practice-ground with an area of 210 ha will probably be established in the Marnewaard, a part of the embanked Lauwerszee. The unsafe zone (about 2,400 ha) extends partly over the Wadden Sea. The area will be used during week-days all through the year.

Breezanddijk. In the nearby future a long-range artillery shooting camp will be transferred from Petten (province of Noord-Holland) to Breezanddijk at the Afsluitdijk. Though shooting will be practised in the direction of the IJsselmeer, the sound pressure of this new activity will be obvious in a large part of the western Dutch Wadden Sea.

3. RESEARCH ACTIVITIES OF THE RESEARCH INSTITUTE FOR NATURE MANAGEMENT

Shore-birds may use the subtidal parts of the Wadden Sea as a feeding or resting site (cormorants, grebes, diving ducks, gulls, terns, whereas other species feed on the tidal flats during low tide (dabbling ducks, Shelduck (Tadorna tadorna), waders, gulls). Especially waders demonstrate a typical behaviour which is regulated by the tides: during low tide they forage on the emerging tidal flats, during high tide they concentrate in large flocks of roosting birds on the islands or mainland-coast. In both occasions birds run a risk to ger disturbed since military activities, as well as recreation, bait digging and several kinds of fishing may prevent them from foraging or cause them to fly up. Both aspects are part of a study on the effects of (all kinds of) disturbance which started in 1980, at the Department of Estuarine Ecology of the Research Institute of Nature Management (RIN) at Texel.

The effects of disturbance on breeding birds are not taken into consideration because relatively much information is available on this matter. These effects may range from no effects at all, more or less frequent flying up of breeding birds (including a higher risk of predation of the eggs) to smaller breeding bird densities in heavily disturbed zones (Picozzi 1971; Dunnet 1977; Kushlan 1979; Robert & Ralph 1975; Ellison & Cleary 1978; Robertsen & Flood 1980; Titus & van Drutt 1981; Parsons & Burger 1982; Safina & Burger 1983), as well as hatching failure due to dying of embryos in the effs as a result of sonic booms of aircraft (Bell 1972; Austin et al. 1972; Rylander et al. 1974). There are many observations that, after some time, breeding birds tend to get used to sound produced by military shooting. However, at this moment it is not clear yet, whether this applies to all species.

Effects of disturbance on non-breeding birds may be studied on two different levels.

1) What is the direct effect of disturbance on the behaviour of birds?

2) What is the ultimate effect of disturbance on the condition of the birds and, as a result of a possible negative effect, on the reproductive success of the birds? In other words: can disturbance affect population levels of birds? (Fig. 4).

Obviously, the first question is a more easy one to answer. However, both aspects will have to be studied to arrive at relevant conclusions on the effects of disturbance on a population level.

Shore-birds may be disturbed when resting at the high tide roosts and when feeding on the emerged flats. Both aspects have been incorporated in the RIN-study. However, research activities are still going on at the moment and have not yet resulted in a general opinion on the significance of disturbance to the birds. The following examples demonstrate something of the kind of work crried out by the RIN so far. Some observations from literature are included as well.

3.1. Effects on roosting birds

In November 28, 1978 a series of test shots was fired in the Lauwersmeer, where new army activities are planned. Aim of this experiment was to quantify sound production in and around the area and to determine the reaction of the birds. These were mainly roosting dabbling ducks and foraging geese. Shots were fired with three 25 mm cannons and a "Carl Gustav" 84 mm MAW. Sound pressure levels were about 80 dbA at 1 km distance and about 60 dbA at 5 km (Smeorenburg 1979). Bird distribution in the area changed considerably during the series of shots. After the first shot thousands of waterfowl flew up and many left the shallow and sheltered channels in the eastern part of the area to move towards the more open central part. (Fig. 5).

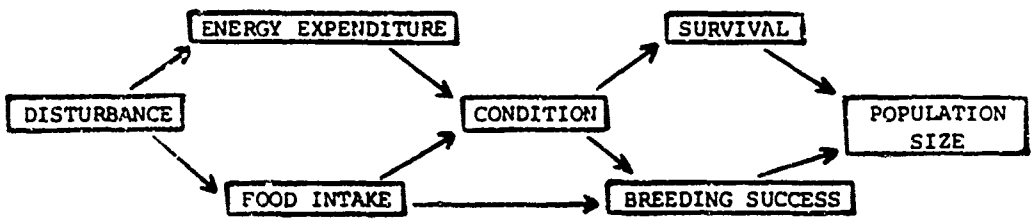

Fig. 4 The effects of disturbance on various ecological parameters and their possible effect on population levels

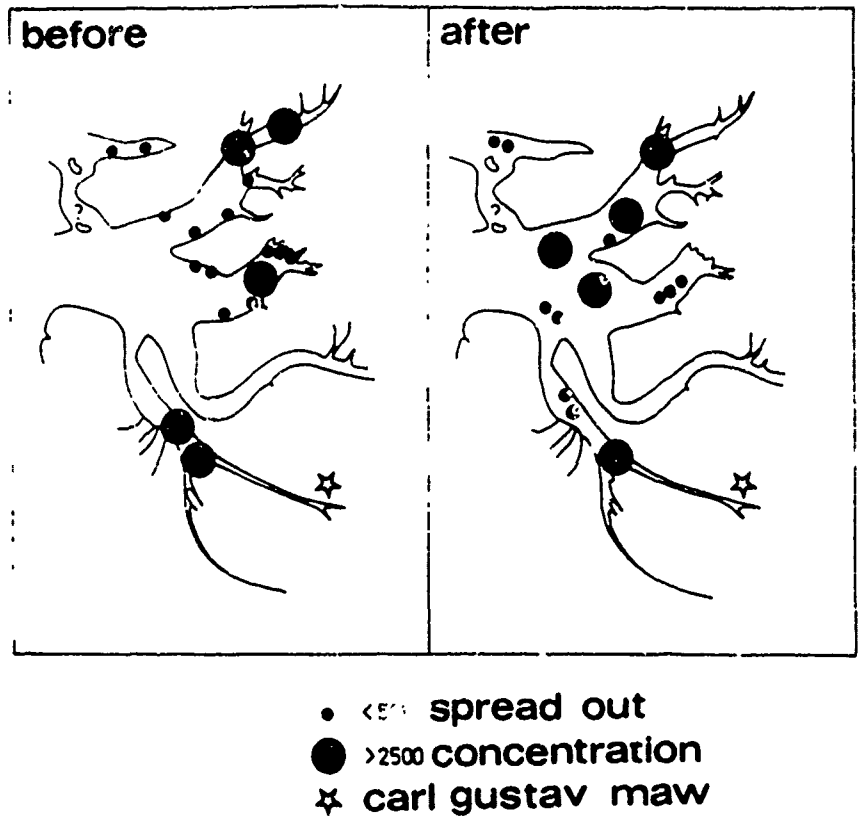

Fig. 5 Distribution of Teal (Anas crecca), in the eastern part of the Lauwersmeer, before and after firing 5 shots with a Carl Gustav 84 mm MAW on 29 november 1978. After Van Eerden & Smit (1979)

Apart from movements away from the areas with the largest sound pressure, several thousands of waterfowl left the Lauwersmeer. After the first shots a kind of habituation could be noted though many of the remaining birds in this area still demonstrated nervous behviour in the course of the day. These data, however, are difficult to interpret since on the day the shooting experiments started, the first ice formation occurred. This might have influenced the bird behaviour considerably and may even have forced a part to leave the area anyway (Van Eerden & Smit 1979). We hope to repeat comparable observations in the neighbouring Wadden Sea in the near future. Tank shooting on the island of Vlieland in combination with the appearance of people caused larger disturbance than the sound itself. When the shooting season starts, reactions of the birds are much more intensive as later in the season. Many wader species which do not react to tank target practices during the day, do show a reaction by night.

Foraging Dunlins (Calidris alpina) have been observed to stop feeding for a moment, after light flashes caused by tank projectilves. They appeared to junp up at the light flashes (De Roos 1983). Flocks of roosting Knot (Calidris canutus) disappeared almost completely from Vlieland during tank shooting exercises (Van der Baan et al. 1958).

Large disturbances of high tide roosts are caused by helicopters and small, slowly flying planes, particularly if they fly at altitudes less than 500 m. Disturbance by fast planes is much less and sometimes hardly or not observable. Military jets at the Noordvaarder shooting range caused little disturbance as compared to low flying, slow aircrafts, helicopters and walking people (Table 1).

Period: July 15 - Sept. 15		Jet at < 1200 m			Helicopter at < 1200 m			Small slow plane at < 1500 m			Walking person at < 250 m			Gulls	Car	Unknown	Mean n/hr
hours	species	n obs.	*	%	n	*	%	n	*	%	n	*	%	*	*	*	
330	Oystercatcher	2100	110	5.2	108	29	27	15	11	73	148	88	57	13	4	11	0.8
150	Bar-tailed Godwit	925	166	18.2	58	43	74	13	11	85	70	52	74	22	13	15	2.2
50	Curlew	299	48	16.1	14	12	100	7	6	86	42	32	76	8	12	9	2.5
Period: Sept. 16 - Dec. 1 and March 1 - May 1 (excl. holiday periods)		Jet			Helicopter			Small slow plane			Walking person			Gulls	Car	Unkown	Mean n/hr
n hours of obs	species	n obs	*	%	n	*	%	n	*	%	n	*	%	*	*	*	*
300	Oystercatcher	1563	27	1.7	84	27	32	3	2		15	8	53	2	3	9	0.3
200	Bar-tailed Godwit	1192	43	3.6	62	44	71	2	2		11	8	73	5	12	17	0.7
30	Curlew	156	7	4.5	12	8	66	0	0		3	3		1	7	7	1.1

Table 1 Reactions to several kinds of disturbance of waders at the Noordvaarder shooting range (Terschelling). Only flocks of over 100 birds were studied (Curlew > 20). A flock was considered to fly up when ≥ 50% of the flock went into the air. Distances of aircrafts to birds are given. In all situations flying altitude was < 300 m. Hours = total number of hours flocks of a particular species were studied; n obs = total number of interactions during the observation periods; * = total number of disturbances resulting in flying up; Mean n/hr = mean number of disturbances (all sources) per hour. Data: Visser (1983).

Disturbance during summer was considerably more intensive than in autumn/spring. The Noordvaarder shooting range is rather intensively used, though less intensive as the one on Vlieland. Birds roosting here are relatively used to all kinds of human activities. Nevertheless jets in summer caused roosting flocks of Bar-tailed Godwit

(Limosa lapponica) and Curlew (Numenius arquata), respectively, to fly up in 18.2 and 16.1% of all interactions studied. Helicopters and small planes even cause more disturbance. The effects of jets, however, are less obvious in autumn, when activities of walking people and small planes are also much smaller. Mean duration of flying was also somewhat shorter in autumn/spring (Tabel 2). Oystercatchers (Haematopus ostralegus) were less easily disturbed and spent less time flying than Bar-tailed Godwit and Curlew.

Before 1957, prior to the shooting activities at Terschelling, during the day in August high tide roosts at the Noordvaarder could be found of Bar-tailed Godwit, Whimbrel (Numenius phaeopus), Knot, Dunlin and Curlew Sandpiper (Calidris ferruginea). Nowadays these species are less numerous here. This could be a result of the shooting exercises as well as increased tourism. From 1957-1973 Bar-tailed Godwit numbers at Terschelling were about half the numbers which were present prior to 1957 and which are occurring nowadays. Possibly intensive

Period: July 15 - September 15							
Species	Jet	Helicopter	Small slow plane	Walking person	Gull	Car	Unknown
Oystercatcher	36(12)	38(3)	50(2)	38(11)	36(2)	12(< 1)	5(< 1)
Bar-tailed Godwit	56(63)	73(21)	114(8)	65(23)	63(9)	21(2)	10(.
Curlew	50(48)	65(16)	83(10)	57(37)	54(9)	22(5)	8(1)

Period: September 16 - December 1 and March 1 - May 1 (excl. holiday periods)							
Species	Jet	Helicopter	Small slow plane	Walking person	Gull	Car	Unknown
Oystercatcher	28(3)	22(2)	48(<1)	36(1)	15(< 1)	9(< 1)	4.< 1)
Bar-tailed Godwit	32(7)	41(9)	168(2)	67(3)	45(1)	17(1)	4(1)
Curlew	33(8)	38(10)	-	62(6)	32(6)	14(3)	9(2)

Table 2 Average duration of flying (in seconds) per hour of observation after kinds of disturbance of waders at the Noordvaarder shooting range (Terschelling). In brackets the average duration of a single disturbance is given. Same criteria as in Table 1 were used. Data: Visser (1985).

shooting activities during this period (including an intensive night shooting programme) has been a reason for this drop in numbers, though our knowledge of large scale population fluctuations is too limited to conclude on this. Curlew numbers from 1957 till present are rather stable. Apart from these changes high tide roosts choice nowadays does not differ very much from that before 1950.

In case of disturbance waders tend to leave the high tide roosts earlier as they would do under undisturbed conditions. When disturbed on the feeding areas they tend to leave earlier to fly to the roosts. Disturbance appears to speed up or to enhance behavioural changes. Bar-tailed Godwits and Curlews on Terschelling in August spend about 15 minutes of extra flying time per day as a result of disturbance. Based on estimates of the energetic costs of flying and the daily energy expenditure this equals about 3% extra energy expenditure per day. Using the same calculation Oystercatchers loose about 1%. At this moment still insufficient information is available whether this extra energy expenditure constitutes a real problem to the birds concerned. Therefore studies on energy budgets and investigations in the possibilities of birds to compensate for lost feeding time are part of the RIN shore-bird study programme, carried out in cooperation with the University of Groningen and the Netherlands Institute for Sea Research.

5.2. *Effects on feeding birds*

During 1983 and 1984 a hide was built on the tidal flats east of the island Texel, to study wader feeding ecology and bird reactions to passing jets. This study spot is situated on the route jets take after exercising on the Vliehors shooting range. Jets were often passing right over the hide at altitudes of less than 100 to a few hundred meters at the most. Generally foraging birds did not react when planes passed, occasionally short reactions were noticed, varying from looking up, stopping foraging for a few seconds, to short flights, generally lasting for 10-30 seconds. Occasionally somewhat stronger reactions could be noted but probably these were birds which had arrived recently in the area (for instance Brent Geese, shortly after their arrival from the Siberian breeding grounds) (Smit, unpubl.

observ.). Strong reactions were noted when relatively slowly flying A 10 jets were exercising at the Vliehors. However, these planes did not approach the hide close enough to study their disturbing effects sufficiently. For the moment we do not expect that passing jets cause shortage of food intake to foraging waders. Most of the birds appear to be rather accustomed to the frequent jet movements in the intensively used Vliehors shooting area, but also in this case easily disturbed birds may have left the area after the first jets had passed. Only a comparison (numbers, species composition) of ecologically equal areas, only differing in the amount of disturbance, could tell us whether such movements actually occur.

Slowly flying planes are known to cause relatively heavy disturbance to foraging and roosting waders. Experiments on the tidal flats south of the island Terschelling show that 10 minutes after a single disturbance of a plane (altitude 360 m) numbers in the study area are back at the same level as prior to disturbance. A plane passing twice (altitudes 450 and 360 m respectively) caused more dramatic effects. After 45 minutes 67% of the originally present Oystercatchers and 87% of the Curlews had returned in the study plot. Observations of a single Curlew during this disturbance experiment show reactions varying from decreased foraging activity during some minutes to a short flight (43 seconds) and interrupted feeding for 3½ minutes (Glimmerveen & Went 1984).

Observations in the relatively heavily disturbed Mok Bay at Texel, where shore-birds are faced with regularly passing helicopters flying towards offshore drilling platforms, generally at altitudes of a few hundred meters, as well as military helicopters often flying at very low altitudes, show that shore-birds feeding and roosting here, may get accustomed to passing aircraf. However, also in this occasion panic reactions may occur as a result of unexpected movements or unusual aircraft types, during which all birds fly up, some of them for several minutes. In these situations succeeding disturbances have still greater effects. Eventually after some disturbances a heron (Ardea cinerea) flying over may cause panic reactions, whereas under conditions without any disturbance a single heron would hardly

cause any reaction (Smit, unpubl. observ.). To quantify bird reactions under such conditions is difficult. However, more information of bird behaviour in these situations is needed to determine the precise effects on the energy budget level.

4. CONCLUDING REMARKS

Bird reactions as a result of disturbance by military activities in the Wadden Sea give the impression that the situation is not yet alarming. It should be realized, however, that we have no data to compare the present situation with that before any military activities ocurred. Moreover, observations at Vlieland and Terschelling suggest that certain species withdraw from disturbance by disappearing from intensively disturbed areas. This possibility will have to be determined through future field observations. Future observations will also have to include more detailed studies of the effects of sound pressure caused by shooting in the Lauwersmeer and of the effects of helicopters and slowly flying planes under different situations of habituation. These observations will have to be incorporated in the long-term study on the effects of all kinds of disturbance on food intake and energy expenditure, which is presently carried out at the Research Institute for Nature Management at Texel.

Since shore-birds to a certain degree appear to get accustomed to a number of military activities, whenever they are carried out frequently and in the same way, a minimalization of their effects to birdlife could be achieved by concentrating these activities in a small number of fixed areas or routes. This applies especially to activities involving vehicles and aircraft and to shooting exercises. As soon as walking or running people are active in the field, disturbance will be much greater. Besides, birds will not tend to get accustomed so easily to those activities.

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DISTURBANCE OF BREEDING BIRDS BY MILITARY TRAINING ACTIVITIES IN THE NETHERLANDS, ESPECIALLY IN HEATHLAND

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INTRODUCTION

Military training activities can affect breeding birds in several ways. They can change the physical environment for example by destruction of vegetation, birds can be killed or nests destroyed and finally birds can be disturbed (Weinreich 1981). Disturbance is supposed to be the main factor which can affect breeding pairs, populations and bird communities. Disturbance can urge birds to leave (expulsion) or it can diminish the offspring of the breeding pairs resulting in low densities or even extinction of populations (fig. 1). It is difficult to assess expulsion, reproduction and extinction directly, so in our case study (Thissen 1983) we measured densities and numbers of species.

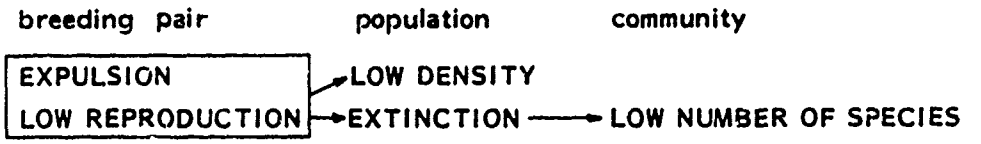

Figure 1 Possible effects of disturbance

DESIGN OF THE CASE STUDY

In the Netherlands there are, apart from fireranges at sea, 31 000 ha of military training areas, which is about one percent of the Dutch territory. Ten percent is coastal area, consisting mainly of dunes and saltmarshes, forty percent is heathland, another forty percent woodland and five percent shifting sands. For our case study heathland was chosen, because this type of landscape is widespread and common in the Netherlands. Besides, in this open country the range of disturbance might be large. Finally, it has a simple structure which makes comparison relatively easy.

To investigate the effect of disturbance by military training activities heathlands with different intensities of military use were compared. In such comparisons it is desirable that the other factors, which influence the composition of bird communities, are equal. Region, surrounding, isolation, surface, structure of vegetation and recreation are such factors (Opdam & Retel Helmrich 1982). The most homogeneous region with heathland is the Veluwe, an infertile sandy region in the centre of the Netherlands, where several extensive heaths are being used as military training areas.

Eighteen plots of about 100 ha each were selected, eleven on training grounds with different intensities of use and seven on other heaths. For these plots, region, surrounding, isolation and surface are more or less equal.

Unfortunately, no selection of plots could be made that were equal concerning structure of vegetation and recreation. So besides the densities and numbers of bird species, three factors had to be assessed: recreation intensity, structure of vegetation and of course military training intensity.

MATERIAL AND METHODS

On the community level, the data were analysed by means of classification using the computerprogramm TWINSPAN (Hill 1979), whereas on the population level a correlation technique was used. Multiple regression is a statistical technique to calculate the correlation between military training activities and birdlife after a correction for differences in recreation intensity and structure of vegetation. The army administers how many military personnel and vehicles make use of the training areas. As to be expected, these numbers are closely correlated: the more personnel, the more vehicles. So if the correlation of military training activities to some other variable is calculated, the number of personnel and the number of vehicles cannot be taken together in one model. One of these two variables has to be selected. To measure the recreation special counts were carried out. The number of persons, the number of vehicles and the spatial distribution were calculated. These three aspects were also clearly correlated. So in correlation calculations one of them has to be selected. The more visitors, the more vehicles and the larger the

part of the area affected. Unfortunately, it is not known how the military activities are distributed within the areas.
Four aspects of the structure of the vegetation were measured: height, the amount of grass, the amount of shrub (which turned out to be very important) and the diversity. The density of birds was assessed by means of the mapping method.

RESULTS

Three main types of bird communities could be distinguished (Table 1). Type A is poor in species and characterized by the presence of Lapwing and a high presence of Black Grouse. Type C is relatively rich in species and characterized by Wilow warbler, Great tit, Blackbird and Chaffinch. Type B is more or less intermediate between A and C. According to these results, military training activities do not seem to have negative effects on the composition of bird communities. All species occur in type A or C, where military training is intense. A lot of species (Stonechat, Tree pipit, Wheatear, Linnet, Yellowhammer, Woodlark, Willow warbler, Great tit, Blackbird and Chaffinch) occur most in type C. Virtually, all these species prefer shrubs or trees. Their occurrence is caused by the presence of shrub in these plots.
For ten common bird species the correlation between density and intensity of military training expressed in presence of personnel was calculated after correction for differences in recreation intensity and structure of vegetation. For military training no significant correlation was found. For some species like the Tree pipit, a correlation based on the presence of shrub was found between density and vegetation structure (fig. 2).

CONCLUSION

No significant decrease in numbers of birds due to different intensities of military use or recreation could be found. The most discriminant factor seems to be the vegetation structure, although areas had been chosen with equal vegetation structure as much as possible. The results demand for further investigations. The number of study areas might have been too low to make differences significant mathematically. According to

another theory, military and recreational activities may reduce reproduction, but losses may be supplied by immigration. Furthermore, species that are sensitive for disturbance might have disappeared already from all our heathland.

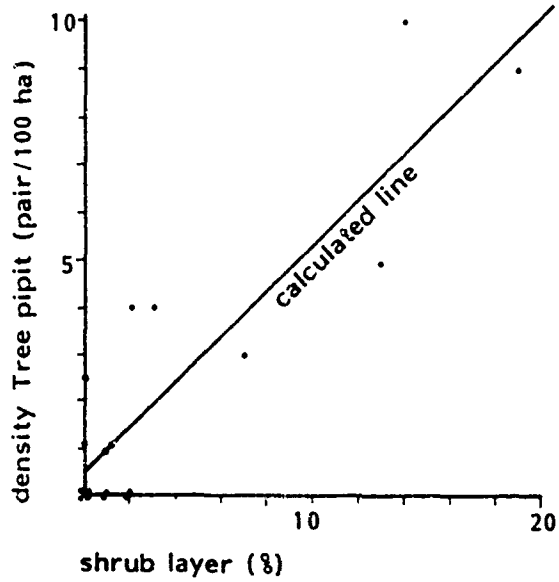

Figure 2 The relationship between the density of the Tree pipit and the shrub layer

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Table 1. Types of bird communities.

Type	A					B										C		
Military training	+	+		+	+			+			+		+	+		+	+	+
Recreation	+	+		+	+	+	+	+		+		+	+	+	+			
Shrub layer (%)	7	1	0	2	0	0	1	0	0	0	1	2	5	2	1	14	19	15
Black grouse (Tyrurus tetrix)	-	4	2	2	-	-	-	-	-	-	-	-	-	2	2	2	-	-
Curlew (Numenius arquata)	3	4	2	4	3	1	1	1	2	-	2	2	1	2	-	2	1	1
Lapwing (Vanellus vanellus)	-	4	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cuckoo (Cuculus canorus)	1	1	-	1	-	-	-	-	-	-	-	-	1	-	1	-	-	-
Meadow pipit (Anthus pratensis)	5	6	6	6	6	5	5	4	7	6	4	6	5	5	-	5	-	-
Skylark (Alauda arvensis)	8	8	8	8	8	7	8	8	8	7	7	8	7	8	7	7	7	7
Quail (Coturnix coturnix)	-	-	-	-	2	2	2	-	-	-	-	-	-	-	3	-	-	3
Shelduck (Tadorna tadorna)	2	2	-	-	-	-	-	-	-	-	2	-	-	-	-	2	-	-
Linnet (Carduelis cannabina)	-	-	-	-	-	-	2	3	4	2	2	3	4	2	2	3	4	4
Stonechat (Saxicola torquata)	2	2	-	-	2	-	3	-	2	-	-	3	4	2	3	3	4	4
Tree pipit (Anthus trivialis)	3	-	-	-	-	-	-	2	-	3	2	4	4	-	2	5	5	4
Woodlark (Lullula arborea)	-	-	-	-	-	-	-	2	-	-	-	-	2	-	-	-	3	-
Yellowhammer (Emberiza citrinella)	-	-	-	-	-	-	2	2	2	-	-	-	-	-	-	3	3	2
White wagtail (Motacilla alba)	-	2	-	-	2	-	-	-	2	2	-	-	-	-	2	3	2	3
Wheatear (Oenanthe oenanthe)	-	2	-	-	-	2	-	2	-	-	-	-	-	-	-	2	2	3
Willow warbler (Phylloscopus trochilus)	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	3	3
Great tit (Parus major)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	2	2
Blackbird (Turdus merula)	-	-	-	-	-	-	-	-	-	-	-	-	-	-		2	2	-
Chaffinch (Fringilla coelebs)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	4	-

Density classes: 1 = one territory largely outside the plot.
(Pair/100 ha) 2 = 1,0 - 1,9 3 = 2,0 - 3,9 4 = 4,0 - 7,9
5 = 8,0 - 15,9 6 = 16,0 - 31,9 7 = 32,0 - 63,9 8 = > 63,9

Density of the Black grouse in individuals per 100 ha.

Species, which occurred only in one plot, are excluded.

ECOLOGICAL ASPECTS OF THE SAFEGUARD OF THE FLORA AND FAUNA IN AN ITALIAN DISTRICT

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SUMMARY

It has been chosen a military District about 600 hectares large in the area of the mountains of Tolfa North-East of the town of Civitavecchia, in which there are chemical-physical-biological laboratories, a range for chemical training and a shooting range for small arms.

The species are considered which in such a District are typical both from the point of view of the flora and the fauna, in order to characterize the environment and to preserve its state of preservation.

The activities carried out by man (experimentations, trainings, etc.) and the checks carried out and going on at present on waste waters from the ecotoxicclogical point of view, are briefly analysed in order to verify thath the waste occurs always in the observance of the current Italian laws concerning the protection of the environment (Merli's Law: 319/76, Law 967/80, Law 927/81).

INTRODUCTION

The uses of zones of territory by the Armed Forces as areas for training troops or for carrying out experimental trials, may legitimately give rise to the question if, in such miitary zones considering the ecological aspect, is the equilibrium of ecosystems respected or , on the contrary, is the environment not safeguarded in its basic components, namely territoty, fauna and flora.

The responsible in NATO organism, within the Commitee facing the challenges of Modern Society have tackled the problem in an open confrontation during the seminary on the conservation of the flora and the fauna in the areas for military training, held in Soesterberg (Holland).

In such contest Italy intends contribute with a study on the environmental characteristics and conditions of the territory called "Comprensorio Militare di S.Lucia" (Military District of S.Lucia), about 600 hectares wide, in the zone of the mountains of Tolfa, north of Rome.

The invitation to contribute has been received with interest both for the deep-rooted conviction of the necessity of preserving the natural environment where we live and work and because we think that it represents an occasion, not to neglected, to make a report in an international contest on the real possibilities of preserving the integrity of the environment even in the presence of experimental activities, as it is in the Military District of S.Lucia.

The survey which has lead to the technical report,

has been carefully made, because of the complexity and the wideness of the territory.

Although it is a circumstantial report in some aspects, as the floristic ones, it is only meant to be an initial contribution and a starting point for a systematic development of ecological survey, which may permit, at any moment a comparison with similar territories and the control of the essential conditions for the safeguard of the environment.

In order to achieve such an objective one is obliged to continue, extend, unify and mutually exchange one's own experience and the survey findings to achieve with mutual cooperation general valid for any Military District or training area.

CHAPT. I

THE DISTRICT AND THE MILITARY ACTIVITIES

I.1. Brief Description

The Military District taken into consideration lies north-east of Civitavecchia, in an area named S.Lucia 6.5 Km from the built-up area. It is delimited by Mount Pocopane (388 m.) in the north-east, by Braccianese Claudia road in the south, by Sterpeto Cape in the west and by Mounth Turco (450 m.) in the east; it is about 600 hectares wide (fig.1).

In the District we find the following:

- the Tecnical Chemical, Physical and Biological Military Centre (C.T.M.C.F.B.);
- the Military Establishment of Materials for NBC Defence;
- a shooting Range for small arms;
- a Range for chemical training .

The zone consist of a partially woody wavy terrain with rolling hills.

The sail is clayey, with outcropping rocks.

I.2. Industrial-like activities

The Technical Chemical Physical Biological Military Centre carries on surveys research and experiments for the development and prourement of materials for NBC defence.

In the above-mentioned activities it discharges liquid effluents that before being let in the environment in a gully named "Fosso della Vite", one chemically and biologically depurated, in full observance of the law n. 319/76 (Merli's Law).
This law fixes both the maximum acceptable lavels of dangerous chemical substances and the bacteriological parameters thet can be let in the receiving gully without altering the equilibrium of the related hydroecosystem (Tab.1).
For such purpose a depurator of the mechanical oxidation type by means of a paddle-rotor is working in the District, down the laboratories which depurates the effluents before the discharge (photo n.1).
The waste waters converge from the logistic departments and the laboratories in it. They are treated, stocked in tanks and periodically discharged in the "Fosso della vite" gully.
Into the same depurator the waste-waters will be convoyed from the manufacturing and testing Department of the Military Establishement of the Materials for NBC Defence now being constructed.

I.3. Training activity

The Range for chemical training is limited to an area of about 15.000 m^2 wich lies in the northern area of the District, in a higher position in comparison with the C.T.M.C.F.B., with a difference in altitude of about 50 metres.
In the northern area contiguos to the Chemical Range the Shooting Range for Small Arms lies.

The drills, both in the Chemical and in the Shooting Range, are carried on respecting the ecosystem and with a proper application of the safeguarding criteria of the area.
In such respect:

- simulators of che...ical agents are used;
- the metheorological conditions are evaluated in order to avoid that such agents, athough harmless, might get out of well defined limited areas;
- everything is decontamined with not toxic materials for the environment;
- prescriptions against fire are implemented to safeguard the forest.

CHAPT. II

ENVIRONMENT

II.1. An answer for the environment

Industrial needs, urbanization, cultivation, therefore deforestation to gain agricoltural land, are causes of profound transformation of the original habitat.

Photos n. 2 - 3 show a correct utilization of the soil carried out in the military owned area which has allowed the conservation of the original habitat, whereas elsewhere there have been profound transformations causing complete upsetting of the original status with the rarefaction and at times distruction of a great number of vegetable species and consequently of animals.

Having a closer look at this to chart this environment, a qualitative graph has been realized searching and locating the more significant flora and fauna existing in the district and in the surroinding area of the mountains of Tolfa.

The photos herein enclosed indicate some characteristic habitats in the district and some species which have been able to be photographed.

II.1.1. FLORA

The distribution of the vegetable inheritance throughout the district is as follows:

- about 550 hectars of woody area;

- about 50 hectars of riddle-higs range rocky hills, natural grazing land, wild bushy area.

The 550 hectars of woody area and the 50 of riddle-high range hills contain a woody and hilly area well preserved and protected which represents a surviving sample of Mediterranean woody area.

The main species in this area is the Turkey oak (Quercus Cerris) typical of the riddle-high range Mediterranean Woodland.

This oak is of the decidous type as in the case of another oak also present here, the "Quercus Pubescens" which does not loose its leaves in autumn but keeps them dry and red on the branches until the following spring.

Other species found here are "l'albero di Giuda" (Cercis Siliquastrum) and the holm-oak (Quercus ilex); there can also be found numerous vegetable species of undergrowth, because the filtration of light through the foliage of the tall trees allows the growth of an especially rich flore.

Here follow the main flora species found in the woody area and in the undergrowth:

- Arbutus unedo (Corbezzolo);
- Asparagus acutifolius (Asparago selvatico);
- Carpinus orientalis (Carpino orientale);
- Cercis siliquastrum (Albero di Giuda);
- Convolvus soldanella (Soldanella);
- Cretegus oxyacanta (Biancospino);

- Ciclamen neapolitanum (Ciclamino);
- Cynara sp. (Carciofo selvatico);
- Cytisus scoparius (Ginestra dei Carbonari);
- Equisetum arvense (Equiseto);
- Genista sp. (Ginestra comune);
- Hedera helix (Edera comune);
- Ilex aquifolium (Agrifoglio);
- Laurus nobilis (Alloro);
- Ligustrum volgare (Ligustro);
- Paliurus spina - christi (Marruca);
- Pirus sp. (Pero selvatico);
- Prunus spinosa (Pruno spinoso);
- Quercus cerris (Cerro);
- Quercus pubescens (Roverella);
- Quercus robur (var.Potraea) (Farnia);
- Quercus ilex (Leccio);
- Rosa sempervirens (Rosa selvatica);
- Robus sp. (Rovo);
- Ruscus aculsatus (Pungitopo);
- Tilia sp. (Tiglio);
- Vaccinium myrtillus (Mirtillo).

In the liste above particular attention should be given to the wild orchids present in the area. Some of these are:

- Anacamptis pyramidalis;
- Dactyloriza maculata;
- Limodorum abortivum;
- Orchis papilionacea (photo n.4);
- Orchis purpurea;
- Orchis laxiflora;
- Ophrys apifera;

- Ophrys sphegodes;
- Serapias vomeracea.

In some woody glade one can notice the presence of "Parmelia caperata"(photo n.5 - 6) on tree trunks. It is a lichen working as a pollution detector; as a matter of fact it tends to disappear if pollution reaches harmful levels.
Therefore, its presence in the district shows that there is not significant level of pollution there, in spite the fact that the surrounding area of Civitavecchia is industrial (cement factories and thermoelectric power plants) and it could cause an environment degradation.
The winds, as it is known, deposit polluting gaseous agent on the vegetation of the surrouding areas for tens of Kilometers from the production site.

II.1.2. FAUNA

A systematic survey of the fauna population in the district presents many more difficulties than the one for the flora population for the obvious reason that there are a grater number of species to be considered.
Furthermore, the fauna is constantly moving and camouflaging (especially certain species of insect); biological cycles and evolving adaptation is considerably more than it is in the flora population.
For the above mentioned reasons we have listed only

some of the most characteristic species, bearing in mind the two main habitats in the district, namely:

- Fauna present in the "Fosso della Vite" or in the surrounding environment(typical environment of the waters inland);
- Fauna present in the woody areas.

Numerous species of inferior Potista have been found in the "Fosso della Vite"; here are some:

- Paramecium aurelia;
- Paramecium trichium;
- Euplotes diadaleos;
- Stentor sp.;
- Stentor caeruleus;
- Chilodonella uncinata;
- Vorticella sp.;
- Rotaria sp.

Among the molluscs there are two species of Limnea, namely the L. Stagnalis and the L. Fluviatilis; furthermore various species of Planorbis.

Among the amphibians there are various species of Gyrinus, Bufo bufo (Toad) and edible frog (Rana).

Much more numerous is the woody fauna with its species representing almost all orders of vertebrates and invertebrates.

There are also countless species of insects belonging to almost alla the main classes.

Here is a list of themain per class:
Among the Coleoptera there are: Copris hyspanus, Orictes nasicornis; Cetonia aurata; Caraous hortensis; Lucanus Cervus; various types of Cochineal (Coccinella septempunctata;Adalia bipunctata; etc.); Cerambix cerdo; Melasoma kaeleri (rare species); Calosoma Sycophanta; etc.
Among the Lepidoptera we find very many species, both nocturnal and diurnal,typical of the Mediterranean bush.
Among the diurnal species we count many species of Pierides (Pieris brassicae; P. rapae; P. napi; etc.), Goneopterix rhamnii; G. cleopatra; among the Papillionides there are Papilio machaon; P.alexanor;Hiphycliaes podalirius ; among the Vanessa there are Vanessa cardui; V. atalanta; Nimphalis polychloros; Aglais urticae.
It is also possible to find Argymnis paphia; Pandoriana pandora; Parargae aegeria; Maniola jurtina, Hipparchia semele; Thecla quercus; Everes argiades; Polyommatus icarus; Lysandra coridon; etc.
Among the nocturnal species there are various species of Sphingida; Sphinx ligustri; Marumba quercus (photo n. 7 - typical species);Deilephila elpenor; Deilephila porcellus (uncommon);Herse convolvuli; Limas tiliae , of Limantridi(Dasychira pudibonda, Lymanthia dispar), of Arctidi(Arctia aulica; A.caya; A. fasciata; Euplagia quadripunctaria; Arctia villica), of Cossidi (Cossus cossus ,

Zeuzera pirina), of Noctuidi (Noctua fimbriata, Noctua pronuba), of Zigenidi (Procris statices), of Sintomidi (Syntomis phegea), the Saturnidae Saturnia pyri, etc.

Among the Ortoptera there are very many species of crickets and locustus, we call to attention: Tettigonia viridissima, Liogryllus campestris, Gryllus domesticus, Oedipoda coeruleseens, Tetrix bipunctata, Tachycines asynamorus.

Note the presence of Ephyppigera ephygger, not very common species, which represents a kind of joining ring between the fossil Orthoptera and the current ones along the line of evolution (post - glacial period).

There are also numerous species of "Ditteri"(Chrysops caecutiens, Culex sp., Eristalis arbustorum, Syrphus ribesii, Echinomyia fera. Lucilia silvarum), "Odonati" (Agrion puella, Lestes dryas), "Dermatteri"(Mantis religiosa, Ameles abjecta), "Eterotteri"(Dolycoris baccarum, Pyrrhocoris apterus, Palomena prasina) and "Omotteri" (Cicada orni, Cercopis sanguinolenta).

Among the birds we find besides all the typical ones of the Mediterranean area, some rather rare species as the "pellegrino" Falcon, the "Astore" (Accipiter gentilis), the royal "Nibbio" (Milvus milvus) and the "Biancone" (Circaetus gallicus).

Among the reptiles we find the green "Ramarro"(Lacerta viridis viridis), the common "Geco" (Tarentula mauritanica), and the"verrucoso"(Tarentula verrucosa) one, the"Lucertola muraiola"(Lacerta sp.), the common "Vipera" (Vipera aspis), the "Colubro di Esculapio"(Elaphe longissima), the "Biscia campagnola"(Natrix natrix) , the "Cervone" (Elaphe quatuorlineata), the "Luscengola"

(Chalcides chalcides) and the "Orbettino" (Anguis fragilis).

Among mammals the most significant species, some of which being protected as endangered species, are: wild Cat (Felis silvestris), the "Istrice" (Hystrix cristata - protected species), the "Martora" (Martes,martes),the "Tasso" (Meles meles), the "Riccio di terra" (Erinaceus europaens).

II.2. CHECKS CARRIED OUT TO SAFEGUARD THE ENVIRONMENT

The purpose of these checks is to evaluate, with reliable standardized and therefore reproducible methods, the biological damages resulting from the action of polluting agents or from the misapplication of effective techniques of decontamination and rehabilitation.

II.2.1. ECOTOXICOLOGICAL TEST

The ecotoxicological tests taken into consideration by the C.T.M.C.F.B. are the ones asked for the E.E.C. regulations (ann.V of the VIth modification no. 79/831), issued in Italy with the Presidential Decree (D.P.R.) No. 827 of Nov.24/81 and published in the official Gazette (G.U.) No. 50/1982.

The Presidential Decree 927(10) in order to asses the risk substance-man established in attached form II a program of test distributed on tree levels in relations to the average quantities of dangerous substances presumably discharged in a year:

- Level 0 : for quantity of 10 t.per year;
- " 1 : " " over 10 t. per year;
- " 2 : " " " 1000 t. per year.

The District falls on level 0 but studies are currently under way in order to come up with a series of methods for carrying out some of the tests called for at level 1 so as to have a further safety margin on the harmlessness of liquids discharged in the environment.
The test of acute toxicity on fish (SalmoGairdnerii) is carried out at Level 0 and the acute toxicity test on Daphia is currently being studied.
The test of algea-growth is being prepared at Level 1.

II.2.1.1. Test of acute toxicity on fish - Level 0

The test is based on the qualitative evaluation of the acceptability of the effluents to verify that the critical threshold over which environmental changes may take place, is not surpassed.
The method consists of evaluating the survival of at least 50% of the animals used as in the E.E.C. regulations, for a period of 48 h.in contact with the effluent.

Species used: Salmo gairdnerii;
Dimensions : 8 by 12 cm. per sample;
No. of animals: 10.

Methodology

The test is carried out in glass tubs with the actual capacity of 50 litres.
The water temperature is constantly kept at 15°C $\pm$ 1

and oxigened at 60-80% through porous stone made of inert material.

Before using the animals for the test, they are acclimatized in "Stabulazione" tubs for 2 days to make sure the mortality is not due to natural causes.

The experiment animals are placed together with dilution water in the sample to be tested in a proportion of 1 to 1 (1 animal/1lt. of effluent being tested).

Simultaneously a check-up is put up where only dilution water (Tab. 2)is palced, but nc effluent.

At this point the animals are introduced in the tub covering it with a protective grate.

The death are checked after 48 h; the effluent is evaluated within the acceptability limits if at the end of the test, 50% or more of the animals survive.

II.2.1.2. Test of acute toxicity on Daphnia - Level 0

The acute toxicity test developed on Daphnia, together with the test of algae-growth, later discussed in this paragraph, will permit in the future to set up an " ecotossicological" on "planctoniche" species to determine whether the effluents of the District are hurtful to this important "trofico" ring of the animal food chain (as it is known the small crustaceans like Daphnia and the monocellular algae are nutritional sources for numerous water-species both superior and inferior).

Starting from this principle and faithful to the E.E.C. regulation (10), we intend to formulate the test

evaluating the devolution of our effluent capable of immobilizing 50% of the Daphnia of the group being tested for a 24 h period. By "immobile" we mean the animals that after a slight stroke of the container holding them are not able to swim during a 15 second period.

The organisms traditionally used for this type of test are Daphnia magna or D. pulex, raised in laboratory, ranging from 6 to 24 h of age at the start of the test.

Dilutions of the effluent being tested will be made deionized water and the number of Daphnia remaining immobile after 24 hrs. will be assessed for each concentration: 20 Daphnia will be used in each concentration.

Of course blanks will have to be set up with only the water in which they grow, to asses the natural mortality.

Since the cumulative immobilization percentage obtained for each dilution is a function of the concentration of the effluent itself and therefore of its dilution, it will be possible to establish the dilution in which there is a 50% mortality rate. One will be able to trace back the average dilution of tolerance to which the effluent will have to be diluted to safeguard the biological environment being considered.

II.2.1.3. Test of Algae growth - Level 1

The test of algae-growth, the methodology of which

is being studied, allows to evaluate the qualitative and/or quantitative presence of toxic substances in checking the acceptability of waste waters.

The test starts off with the principle that there is a proportionality between rate of algae-growth and concentration of non specified toxic pollutant agents.

In this test a monocelluiar algae is chosen having the feature of not making up colonies.

The "algae concentration" (No of cells/ml) is proportional to the Spectrophotometric absorption, so that a curve of calibration of the type shown in the figure 2 can be constructed.

The maximum rate of algae-growth, raised in appropriate cultures having defined chemical-phisical compositions and characteristics, with in absence of polluting agents, will follow trend 11 (Fig. 3).

With the presence of toxic agents, the rate of growth will be slowed down proportionally to the concentration of toxic agents present, as in curve 2 (Fig. 3).

II.2.2. Microbiological tests

The waste waters, after depuration undergo a periodical bacteriological check to determine a possible presence of microorganisms, indicating pollution, within the limits accepted by the existing legislation (Tab. No.1)

Check-up frequency : monthly;

Methodology employed : rapid sampling and determination through dip-slide.

Bacteria searched : the analysis is carried out twice to determine:

1) Total microbic load of an environmental nature (20°C);
2) Total microbic load of an animal nature (37°C);
3) Load of the atipical "coliformi" (37°C);
4) Load of the "coliformi fecali" (44,5°C).

For determinations 1 and 2 a certain type of culture soil is used (Agar feeding); for 3 and 4 a different one (Mac Konkey "agarizzato"); the difference in incubation temperature favours the growth of one or the other of the bacteria.
The samples are placed in sterilized bottles "Abbé" taken from 4 pick-up points; two in the starting point and two in the final point of the depurator discharge - this is done to follow the trend of the microbic load along the bed of the water flow and to establish whether the depurator lets out with the waste waters microbic loads tolerable for the natural environment (habitat).

CHAPT. III

DISCUSSION

III.1. Considerations on the preservation of the environment and comparison with the surrou ding environment.

Of the about 600 hectars making up the District, less than 1% is directly utilized for military purposes.

This means that virtually the whole area been able to remain uncultured, that is free of modi fication by man.

On this part of the District the flora and the fauna have been able to exist without modifications or endogenous upsetting which might have interfered or damaged the natural habitat and life cycle.

The same can be said of the section of the District (about 5 hectars) having a closer connection with the istitutionalised activities since no profound alterations, bearing harm to the ecosystem, have been built and general facilities have been set up.

The governing regulations have been followed to the letter and all the possible means of anti - pol lution measures have been adopted to safeguard man and his working environment(canalisations, depurations, filerings etc.both for waste waters and the gaseous erfluents).These measures have allowed to exert a marginal

influence on the environment and maintain it pratically unaltered.

The problem connected with the esogenous components to the District is of a different nature.

The surrounding territor, has been throught the years profoundly altered both because of agricoltural settlements and industrial plants.

The agricoltural settlements, with deforestation and cultivation of the land altered the natural habitat and the relation among the environment, the flora and fauna giving rise to new life cycles and alterations in population rise of animals and vegetable species.

On the contrary the industrial plants have been able to hinder directly the conservation of the District in its original features by depositing with the help of the wind polluting agents;nevertheless no sensible effects have been found.

III.2. CONCLUSIONS

The military command, according to the laws now in force about defence and protection of natural environment, carries out in the District all the necessary safeguard measures in relation to the histitute's activities.

Consequently, in the whole area, all the species of flora and fauna survive pratically unaltered; moreover some species of fauna, which were in danger of life in the surrounding areas, have found a place of refuge in the District by adapting themselves to the new environment and preserving their life cycle. Very little sensible, at the moment, the pollution effects coming from the industrial plants of the near town.

The systematic microbiological and ecotoxicological checks, carried out during the last years in order to control the "health" of the environment, have allowed to find the favourable ecological situation as a main result of this theoretical-experimental survey.

It is to be noticed that, besides the controls kept in accordance with the laws, many complementary checks have been carried out for institute's purposes, so that it has been possible to observe the phenomena having at disposal a greater amount of data.

On the whole the control activity has had the role of a real study about the ecosystem.

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Tab. 1

Chemical and bacteriological parameters in according to Merli's law (n° 319 - Tab.A).

N°	PARAMETERS	CONCENTRATIONS
1	pH	5,5 - 9,5
2	Temperatura °C	-
3	Colore	
4	Odore	
5	Materiali grossolani	Assenti
6	Materiali sedimentabili ml/l	0,5
7	Materiali in sospensione totali mg/l	80
8	BODs mg/l	40
9	COD mg/l	160
10	Metalli e non metalli tossici totali (As-Cd-Cr(VI)Cu-Hg -Ni-Pb-Se-Zn)	3
11	Alluminio mg/l come Al	1
12	Arsenico mg/l come As	0,5
13	Bario mg/l come Ba	20
14	Boro mg/l come B	2
15	Cadmio mg/l come Cd	0,02
16	Cromo III mg/l come Cr	2
17	Cromo VI mg/l come Cr	0,2
18	Ferro mg/l come Fe	2
19	Manganese mg/l come Mn	2
20	Mercurio mg/l come Hg	,005
21	Nichel mg/l come Ni	2
22	Piombo mg/l come Pb	0,2
23	Rame mg/l come Cu	0,1

N°	PARAMETERS	CONCENTRATIONS
24	Selenio mg/l come Se	0,03
25	Stagno mg/l come Sn	10
26	Zinco mg/l come Zn	0,5
27	Cianuri totali mg/l come CN^-	0,5
28	Cloro attivo mg/l come Cl_2	0,2
29	Solfuri mg/l come H_2S	1
30	Solfiti mg/l come SO^-	1
31	Solfati mg/l come SO_4	1.000
32	Cloruri mg/l come Cl	1.200
33	Fluoruri mg/l come F^-	6
34	Fosforo totale	10
35	Ammoniaca totale mg/l come NH_4^+	15
36	Azoto nitroso mg/l come N	0,6
37	Azoto nitrico mg/l come N	20
38	Grassi ed olii animali e vegetali mg/l	20
39	Oli minerali mg/l	5
40	Fenoli totali mg/l come C_5H_5OH	0,5
41	Aldeidi mg/l come H-CHO	1
42	Solventi organici aromatici mg/l	0,2
43	Solventi organici azotati mg/l	0,1

N°	PARAMETERS	CONCENTRATIONS
44	Solventi clorurari mg/l	1
45	Tensioattivi mg/l	2
46	Pesticidi clorirati mg/l	0,05
47	Pesticidi fosforati mg/l	0,1
48	Saggio di tossicità	-
49	Coliformi totali MPN/100ml	20.000
50	Coliformi fecali MPN/100ml	12.000
51	Streptpcocchi fecali MPN/ 100ml	2.000

TAB. 2

Composition of dilution water for the test of acute toxicity on fish.

SOL. A	400g $CaCl_2$ $6H_2O$ 36g NaCl 11g $NaNO_3$ bring up to volume 1000 cc with H_2O
SOL. B	189g $MgSO_4$ $7H_2O$ 99g $NaSO_4$ bring up to volume 1000 with H_2O
SOL. C	34g $NaHCO_3$ bring up to 1000 with H_2O

To every 100 litres of distilled water add 40 ml of Sol.A, 40 ml of Sol.B and 400 ml of Sol.C, so that the total hardness of the solution has a value of about 100 mg/lt in $CaCO_3$.

Photo 1. Depurator plant.

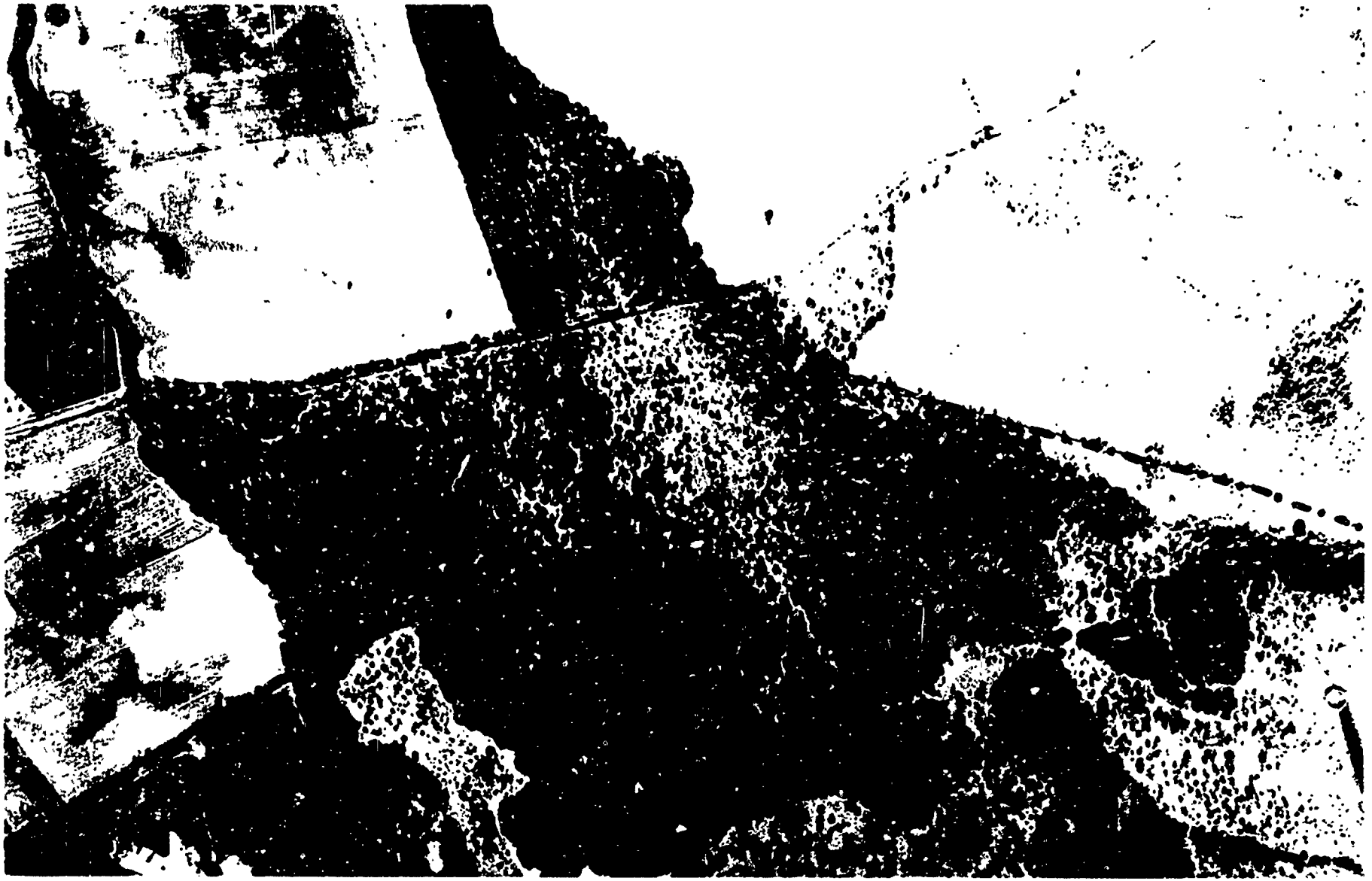

Photo 2. Aerial view of the military district west boundaries with limitrophe agriculture areas (scale 1:3000).

Photo 3. Ground view of area shown in photo 2.

Photo 4. Orchis Papilionacea.

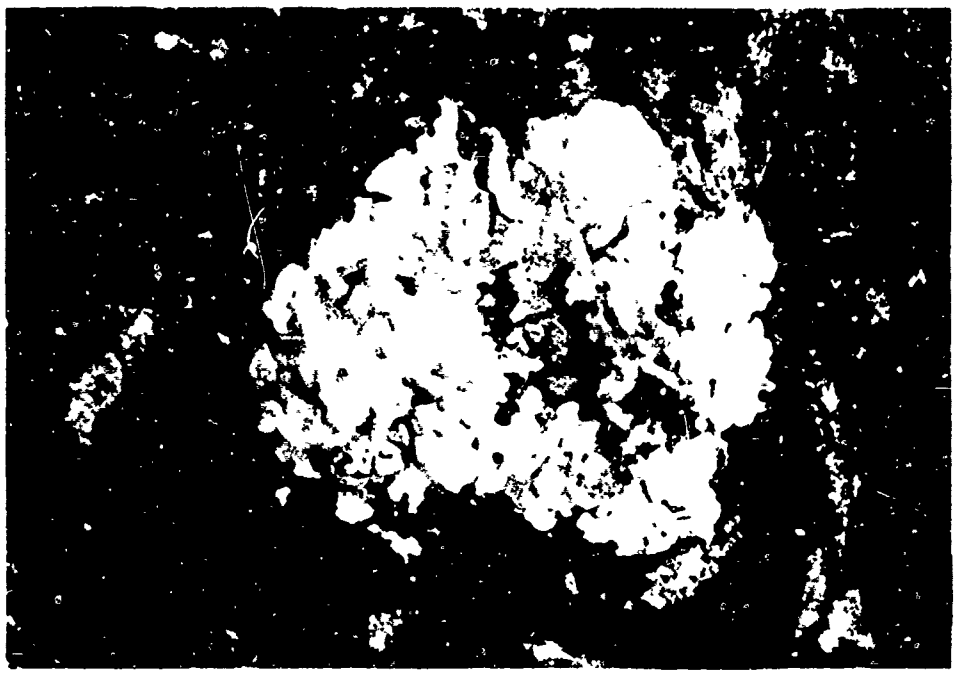

Photo 5.

Photo 6.

Photos 5 and 6. Two different pictures of Parmelia caperata lichene.

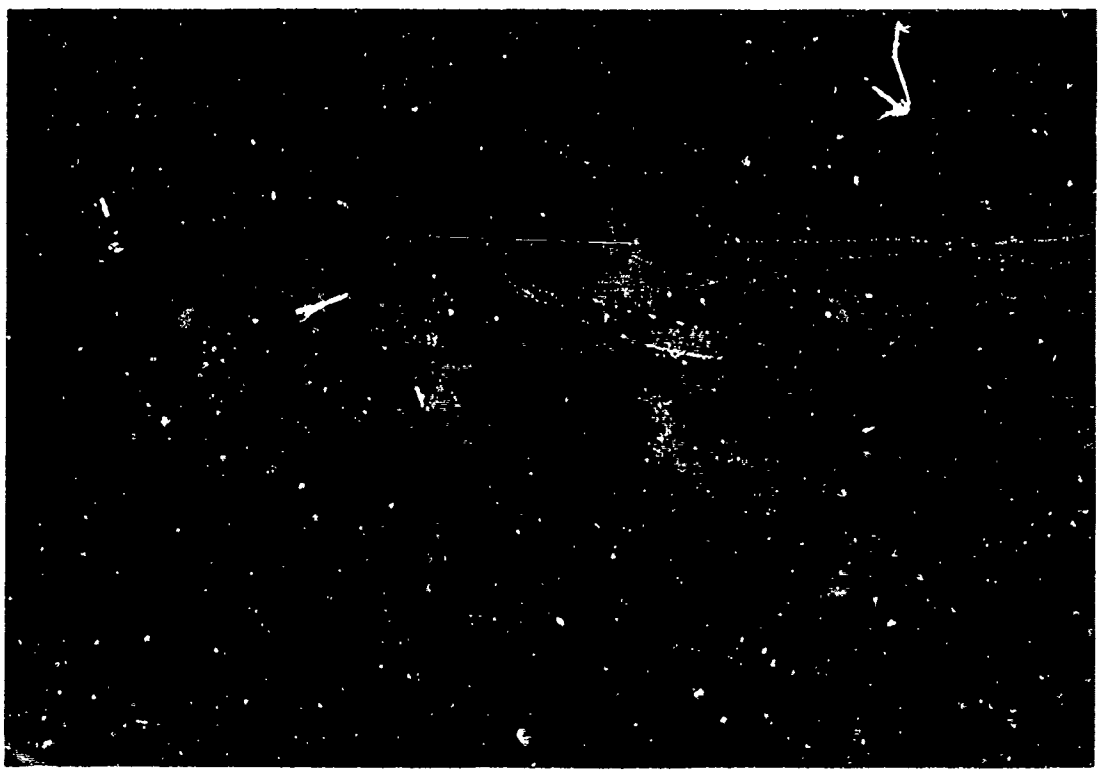

Photo 7. Marumba quercus.

MOD Germany - U II 5
Landwirtschaftsdirektor Friedrich Lenz

Maintaining Military Training Areas of the Federal Republic of Germany with Regard to the Protection of Landscape and Nature

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Due to the lack of space in the Federal Republic of Germany it is necessary to handle nature and landscape with care, to restrict the consumption of these goods. If the population density is a measure for the lack of space in a country some figures may illustrate this:

> The population density of the Federal Republic of Germany with 247 inhabitants per km² is only exceeded by the Netherlands and Belgium with 318 and 315 inhabitants per km² respectively. Great Britain with 225 inhabitants per km² has a similar population density, while Italy with 180, Luxemburg with 135, Denmark with 114, France with 94 and Greece with 67 inhabitants per km² follow Germany, in some cases with a wide margin. The NATO partners U.S.A. and Canada have a population density of 24.3 and 2.4 inhabitants per km² respectively.

Inevitably this lack of space has the consequence that facilities of the Federal Armed Forces lie in the immediate vicinity of dwelling areas and are perceived as disturbing. However, they are also located away from settlements at places, which at the same time are vacation and recreation areas, and again they are felt as being annoying. Precisely the training areas in remote regions are characterized by special scenic beauty. Like in many other countries it is true for the Federal Republic of Germany that regions with low agricultural yields are scenically most attractive. As an example in the Federal Republic of Germany let me mention the training areas in the Lüneburg Heath and the numerous exercise areas in the German central uplands.

With the acquisition of land for military purposes these regions suffered the smallest economic damage, on the contrary, the installation of a garrison could considerably improve the economic power of these regions so poorly structured

formerly. But now that the awareness of major parts of the population has changed especially with regard to the relationship between economy and ecology, it is important to avoid ecological damage as far as possible.

The declaration of the German Federal Government of September 15, 1983 has to be seen within this context. Among other things it says:

> "The biotopes of wild plants and wild animals are affected and/or destroyed for various reasons.
>
> Hence, the Federal Minister of Food, Agriculture and Forestry has taken up work on a program for biotope protection to provide better protection for indigenous species of plants and animals and their biocenoses."

This statement especially touches military activities in open terrain.

In the permanent conflict between military mission and environmental protection an acceptable compromise has to be found.

If there is an exclusive implementation of military training schemes, permanent and in part irreversible damage to vegetation and soil cannot be avoided. However, if environmental protection were given priority, training schemes in open terrain would no longer be feasible.

As mentioned before, a continuous compromise is established between the two envisaged gouls, but it also affects nature and landscape. In the following I would like to give you some information on how the Federal Armed Forces endeavour to eliminate damage done to the landscape, to prevent new damage and to reconcile military utilization and environmental protection.

For over 25 years terrain maintenance groups exist with 113 Garrison Administrative Offices whose task it is to preserve the substance of the open spaces used by the military. It is of special importance that this functional area is assigned to the civilian Federal Armed Forces Administration. An incorporation of terrain maintenance into the military chain of command would not only affect the technical independence of the personnel within the framework of its tasks. Then

the permanent conflict of goals between preservation of the countryside on the one hand and military necessity on the other hand would not be decided by carefully weighing technical arguments but by military order, which by its very nature would probably have its preponderance with the military necessities.

However, this clear separation of command authority and administration also has advantages for both sides. It relieves the forces from administrative tasks and makes them free for military tasks only. The administration on the other hand with its specially trained personnel, which is only subject to instructions from expert superiors, can work more professionally and efficiently.

This organization of terrain maintenance, whose tasks will be dealt with in the further course of this paper, today comprises a total of approx. 3,000 staff members, who have modern machinery and equipment with a current value of approx. 100 million deutschmarks at their disposal. The equipment includes everything required for the cultivation and maintenance of the various types of grounds, from the simple lawnmower to gear used on 240 hp tractors for loosening the soil down to a depth of 1 m. In the last few years the expenditure for personnel and material of this important technical service has been constant at approx. 200 million deutschmarks per year.

At the beginning of terrain maintenance - let us say: in the sixties - its task besides gardening in the garrison administrative areas consisted almost exclusively in removing the damage caused by heavy-duty traffic in exercise areas. This damage increased when new weapon systems were introduced, when heavier and faster vehicles churned up the soil. However, it was recognized soon that the damage done to the landscape increased faster than the removal of flat damage was possible. In addition the necessary area extension of nearly all training areas is not possible for various reasons. Primarily this depends on the lack of space mentioned in the Federal Republic of Germany and on the lack of land going with it. Due to this circumstance the burdening of the too small training areas by increasing military utilization keeps growing.

It is to be expected that the individual training areas will become unusable for training purposes due to erosions, swampings and total destruction of the soil structure. Totally destroyed parts of landscape are then left behind.

However, given the scarcity of land mentioned at the beginning this cannot be accepted. In the 1970ies the implementation of preventive measures, as far as they were not undertaken by the Construction Administration, was added to the tasks of the terrain maintenance groups. In particular metalled, terrain-adjusted roads were built so that traffic can take place under weather conditions, which normally would cause grave damage to the unprotected soil.

These roads have proved to be excellent. Apart from the fact that the training area is now usable in any weather, the unprotected soil was to a large extent freed from vehicle traffic so that far-reaching recultivation measures were worthwhile undertaking. After initial failures these works - also in this case - resulted in new experience. Today we know that we have to aerate the terrain by mole drainage so deeply that the compacted layers, which have formed in the soil due to vehicle traffic, are penetrated. Then the water can seep into the ground where it comes down as rain and does not cause either erosions or swampings. Moreover, the practical consequence of this finding was that a great number of rainwater retention basins formerly considered necessary is no longer required if such recultivation is carried out regularly (approx. every seventh year). We have learnt that the most important task in terrain maintenance in training areas is to get water unter control to "get the knack of it."

By intensive construction of roads, by far-reaching recultivation and by taking measures for the drainage of water we succeeded in turning the military training areas green again. The terrain maintenance groups have had the biggest share in these works. Where it is green, life will spring up. In the eighties not only we but also recognized scientists of German universities discovered all of a sudden that biocenoses have developed on military training areas, which on private land have long been believed to be lost. What was the reason?

Today our findings may not yet be complete, though the following reasons may account for it:

- General farming pacticel hardly any chemical agents such as herbicides, insecticides and fungicides are used.

- The application of mineral fertilizer is restricted to a minimum.

- The development of animals and plants in the biotopes is not disturbed by human recreational activities and encroachments of cultivating farmers.

- On training areas humid areas, that have become so rare, are not drained down to the last hole in order to make profit from the soil.

- On training areas copses are welcome, e.g. as cover, while in normal agriculture they have long been removed.

This list could be continued, each individual factor of those mentioned in turn causes in nature a certain positive development, which is in the interest of nature protection.

I have already mentioned that as a rule the training areas are too small. If due to the interests of nature protection additional claims for areas are made, it is to be expected that the training areas will be reduced in size even further. Today in the eighties we are confronted with these problems. But we try to find solutions which satisfy both sides, the environmentalists, the biologists and zoologists on the one hand the training troops on the other hand.

This is possible since not all parts of a training area are used with the same intensity. For example the troops are not obstructed if a humid area or any other type of biotope, in which nature can develop freely, lies in a safety area not usable anyway. Thus there are training areas of which 20 % or even more of the terrain is officially subject to nature or landscape protection or which can at least be regarded as such areas.

Of course these facts affect the work of the terrain maintenance groups as well. More and more demanding activities in biotope cultivation, biotope creation and biotope management come to the real tasks already described such as the elimination and prevention of landscape damage.

With a few examples I would like to try to explain the different concepts and the activities going with them.

On the edge of the British training area at Haltern-Borkenberge there is a 60 ha area of heather moor, which due to the acquisition of land for the establishment of a German garrison training area now lies in the midst of the military area. With regard to its further development and to the existence of its characteristic flora a moor area is extremely sensitive to the influx of water rich in nutritious substances, to the drainage of excessive water and to the impact of mineral fertilizers and agricultural pesticides carried with the wind. In order to prevent the body of moor from drying up on the one hand and in order to preserve a dry training area as large as possible around the moor on the other hand, foil sheets were buried in the soil in order to regulate the moor water level. Eutrophication is prevented through special care taken during mineral fertilization. This example, which applies to numerous similar cases as well, describes biotope cultivation.

Biotope erection in the last few years mostly happened unintentionally. For example a steep slope of the garrison training area at Ulm-Lerchenfeld was continuously rutted by tracked vehicles. Once the tank roads had been built, a dry grass juniper heath community developed, which as biotope has the typical landscape character of the Swabian Alb. It is self-evident that biotopes "created" in such a way will subsequently be cultivated as well. The necessary human interference with the biotope is often only very small, however, the protection against external impacts requires very large efforts.

Sludge dumping basis and rainwater retention basins may serve as examples of how the creation and protection of the biotope overlap. Once such basins had been built, amphibians appeared after a while, which preferred these muddy waters as spawning grounds. Without further reflection the basins would have been cleaned routinely during the developmental period of the spawn and hence the new generation of amphibians would have been killed. Now the work is planned in such a way that the basins are only cleaned after the developmental period of the spawn has ended. Without extra work considerable success is achieved in the preservation of species of threatened animals.

Expert knowledge is especially required for biotope management. It means the gradual conversion of a piece of land cultivated by man into a natural biocinosis of animals and plants. In order to clarify this I shall mention an example where special efforts were involved. On a firing test site there is an

approx. 3,000 ha moor area, which is to a large extent denatured due to agricultural use thirty years ago and due to extensive drainage measures. Today the area is no longer cultivated, since it is closed mainly due to the firing activities. Though the area is denatured to a large extent, as I have mentioned above, a typical moor or follow-on vegetation has developed, while rare species of insects and species of birds listed on the so-called "Red List" of threatened animal species have turned up. Since the entire terrain is predominantly owned by the Federal Armed Forces, expert agencies of the government of Lower Saxony shall now try to renature the heather moor. First of all it is necessary to provide substitute areas for the few farmers still working in this area or to indemnify them. Then a gradual disassembly of the drainage facilities is required so that the moor body progressively refills with water and the typical moor vegetation, which now only exists in few places, spreads to the entire area. The first step for the execution of this project was made in December, 1983, when the government of Lower Saxony promulgated an enactment whereby this area was to be turned into a nature reserve. It will be especially difficult to prevent mineral fertilizers and agricultural pesticides from drifting with the wind into the heather moor to be recreated. To this effect the nature reserve would have to be enlarged to such a size that considerable resistance from farmers which would be gravely affected is to be feared. The Federal Armed Forces are in favor of this project, even if the disassembly measures will be a certain obstruction for the firing operations for more than about ten years. To what extent a total rewatering is possible, is being studied at present.

The few examples I have mentioned, show that nature protection and biotope cultivation can definitely be reconciled with military interests. But they also raise problems, which in conclusion I wish to discuss briefly.

The creation and cultivation of biotopes on military training areas is feasible more easily than on private agricultural land. As a consequence the Federal Armed Forces have to argue with numerous population groups and individuals demanding access to these jewels of nature, some of which are so rare. This is often neither to the benefit of the biotopes nor to the interests of the Federal Armed Forces.

A modern army has to be flexible. This entails that changes in the utilization of public land are not excluded. Both the Federal Armed Forces and their personnel

working in this special field are the first to regret the loss, if a carefully cultivated biotope, that was created with labour and love, has to give way to a construction measure or to the installation of a firing range. It is hardly conceivable how the public pressure from citizens' action groups and environmentalist groups, not to mention official representatives of local governments, will grow if a nature cell created by the Federal Armed Forces themselves has to be removed for military reasons. In these cases the question arises whether it would not have been better to forgo the installation of the biotope or at least its publication.

However, I do not wish to finish my paper with this sentence, which makes us reflect. I would like to assure you that the terrain maintenance service of the Federal Armed Forces, the head of which I am, is fully dedicated to the cause of nature and endeavours to the best of its abilities to create a relationship between nature and the armed forces as undisturbed as possible.

Topgraphical conservation measures and cultivation on military training areas.

By Ulrich V. Coler

It is a good thing that the population's environmental awareness has increased, particularly in nature conservation - late, but hopefully not too late.

It is unfortunate that the environmental groups (the Green's National Trust, etc.) are as much infiltrated by ideologically coloured social reformers as other institutions.

Unfortunate because conservation is one of the most urgent concerns of our society, effecting all social stratas and is being mis-used for dangerous political adventures. The Bundeswehr is particularly effected by this.

It is quite easy to place in the mind of shallow thinking people, that a tank is a "monster" destroying small trees, or to associate a combat aircraft with breaking the sound barrier over a city.

What is reality?

I will attempt to picture the actual relationship objectively so that you can reach a balanced judgement.

Firstly, which factors most adversely effect the environment? Beginning with the fauna and flora.

The rapid increase in industrialization in the last decade and the apparent compulsion to exploit agricultural and forestry areas economically has led to the use of chemicals to promote growth and insecticides to kill pests. This not only contaminates the soil but also the water table. In addition this interference with flora and fauna disturbes the natural cycle. This can be shown in countless chains of events. For example insecticides kill all kins of insects, including bees. Birds, such as Coal-tits live from mosquitos and flies, others eat pests in forestry areas, such as bark-beetles, lice and many others. In the meantime it has long been realised that the use of chemicals in cultivation triggers an unknown chain-reaction. What else damages nature?

Keeping roads clear of snow and ice has meant the use of large amounts of salt, particularly on Motorways and busy national roads. At the NATO Training Area BERGEN salt is only strewn on those roads open to public traffic and those where the training area HQ is

responsible for maintenance. In both cases, salt is used very sparingly. This winter, a trial will be undertaken to replace salt with sand

We have already made several attempts during winter 1980-81 to meet our responsibility for keeping roads open using sand.

It is often the many weekend excursionists, barbecue parties, mushroom-pickers etc., who understandably have the need to relax away from the crowded city, who impair the environment considerably. Naturally the environment is also affected by industrial gases. Consider the large training areas such as BERGEN with almost 115 square miles, MUNSTER, GRAFENWÖHR, HOHENFELS, RAUMHOLDER, SENNELAGER or EHRA-LESSIEN. Only very limited cultivation is carried out in these areas, not with the object of a large harvest, but to maintain the ecological balance. (e.g. combat erosion etc.) It is not therefore necessary to artificially fertilise the soil to make it especially fruitfull, nor to use insecticides to combat pests. The cultivation of these areas is biologically self-sustaining, the use of intensive, artificial, farming methods is therefore unnecessary. On nearly all of these training areas firing is in progress, on weekdays from 0800 o'clock in the morning until midnight. Alone on these grounds the public are not allowed access to the areas. The whole wear and tear from campers, barbecue parties, mushroom-pickers and housing development is excluded. Because firing of all possible calibres is carried out, infrastructure in the target area such as road work, building and industrial construction is impossible. Here one will certainly interject that driving with tanks or firing with artillery causes more damage than road works or building or other artificial construction. This is not so, in no other part of Germany does game find more peace than on the training area, and only in a few places so much game. Not for nothing have certain animals survived on training areas, where elsewhere they are almost extinct. For example in BERGEN there are breeding Black Storks, Osprey, Racoons, Heron, Black Cock and sometimes Sea Eagle and Cranes, also Newts and rare insects such as the Stag Beetle. That the training area has a large population of Red, Roe and Fallow Deer, Wild Boar and Foxes need be hardly mentioned.

Also the brooks and waters on the training area, the approximately hundred lakes or ponds and running water have got Trout, Carp, Trench and Pike, is a sign that they are biologically pure. The reason is obvious, no polution flows into these waters.

Deep-fording and submerging exercise basins on the training area have isolated water from the rest of the water on the area to prevent possible polution due to oil or dirt. These basins are constantly tested to ensure that the water table does not become poluted.

Usually the training area is only driven on (with tracked and wheeled vehicles) at weekends when units are exercising. As a comparison: The Training Area BERGEN with nearly 30.000 hectares is not much smaller than BERLIN with its 43.000 hectares.

When, as is sometimes possible, a whole Division is exercising on the training area at the week-end, this consists of nearly 1.000 tracked and4.800 wheeled vehicles. In WEST-BERLIN there are 500.000 vehicles. This alone shows how much higher the air polution through carbon-monoxide must be in relation to the training area. I would like to mention in passing that no chemical warfare, of any kind, that could polute the soil, or water, is used on the training area.

One could almost think that there are not any polution problems on Bundeswehr training areas, according to what I have said until now. This is nearly right, but cultivation must also be undertaken on training areas too. If this were not the case trees could rapidly increase, leaving no open areas for training. Apart from this every training area tries to retain the typical landscape of its area. On BERGEN it is the heather on the heath and the juniper bushes and the natural Lower Saxony flora and fauna. This naturally requires measures to be taken.

What are the adverse effects to which a training area is subjected?

1. Forest fires

Particularly in the dry season, red hot pieces of ammunition cause forest fires. For this reason every training area has a permanent Fire Service; in BERGEN this consists of 40 men and 10 modern fire engines. The dilemma that the Officer, or non-commissioned officer, in charge of a firing range finds himself in is to find a compromise between the length of firing time and the time taken to put out fires. If every time a fire broke out firing was stopped in order to put it out, hardly a minute's firing would take place in many seasons. Sometimes a small fire must be left until it becomes a danger to a forest, or plantation. To find a right moment to send in the fire brigade is not always easy. As much as the forestry official fears the forest fire, so useful can the burning of dry grass on the firing range be.

Nowhere does the heather bloom so well as on a burnt out clearing. Assuming that the soil is damp so that the roots survive. Certainly countless creatures will be destroyed by a fire, but this is not so devastating as chemical polution. Experience shows how quickly the local Biotope recovers after a fire. In particulary dry seasons, firing is restricted, at times the use of illumination, phosphorus, signal and smoke ammunition is banned. If a forestry area is burnt, or destroyed by high winds, close-operation with the forestry administration in planting anew is carried out. Forestry economies, fire resistance and landscape factors are taken into consideration. It is true that the forestry offices have commercial interests to follow, however, the views expressed above have priority. This prevents large mono-culture developing. The forestry offices, in liaison with the training area Headquarters, lay down fire breaks and carry out fire prevention measures, such as, planting types of timber that is very fire resistant. These measures cost between 15 and 20 % of the forestry office out-lay and are paid for from Bundeswehr funds.

2. Damage caused by traffic.

Certainly the forestry offices are often engaged in futile work, because again and again a tank drives through a plantation, or an artillery shell detonates in a tree top and showers the forest with schrapnel. For this reason impact areas for indirect fire weapons have been created, in which only low vegetation is grown. To protect the plantations and other critical areas yellow-topped posts are placed around them, which indicate to the exercising troops that these areas are out-of-bounds to vehicles.

Incidently the ground pressure of a tracked vehicle is lower than a wheeled vehicle. Apart from this there are large areas of moor, swamp and water-meadow, where tanks are unable to drive.

Training area regulations and detailed briefing of troops means that as a rule exercising troops adhere to these restrictions. Mistakes occur and black sheep are to be found in any organisation, but their depreciations to the landscape are hardly worth mentioning.

3. Damage through firing

Large armoured formations also need exercise areas, in particular firing fields for battle firing with distances up to 4000 m, mostly in open terrain with low cultivation available. Damage caused by firing and schrapnel effect on game is insignificant. Last year not a single animal cadaver was found which could be attributed to firing.

Injury to game through firing or vehicle traffic seldom happens and bears no relation to that which takes place outside of training areas. On the contrary the number of animals killed on roads and motorways in a comparable period runs into thousands

4. Land management

For the creation of open areas, known as subsidiary forestry areas, the training area administration has cultivation operations, which manage the areas so as to make them suitable for training of troops. In BERGEN 1.200 hectares are so cultivated.

Which factors effect these open areas?

Due to driving, especially with tracked vehicles, or through the effect of firing explosive ammunition small flora is damaged or destroyed. surface water does not seep into the ground due to compression and starts to flow into depressions, causing erosion. This erosion is the most significant problem for nature conservancy on the training area.

5. Noise abatement

On some training areas, due to close air support with live ammunition, noise annoyance is unavailable. Even here the Bundeswehr attempts noise abatement by restricting flying times, laying down flight in- and out-routes and limiting low flying. Similarily measures against firing noise are also undertaken.

Comprehensive measurements have shown that the noise level in a village or on a training area neighbouring town, is much higher from lorries than from firing.

There are also natural possibilities for the maintenance of the area such as the use of local sheep flocks to keep the heather healthy and countless bee hives for polination. On the training area there are 160 bee keepers with approx. 5.000 swarms of bees during the blossom season. As each swarm has nearly 50.000 bees, on the training area there is a quarter of the Chinese population in bees. A passionate bee keeper on the training area is of the opinion that Europe would be a gigantic steppe without its bees.

6. An important aid to cultivation is a proper water supply. Water does not only come from surface waters but also from evapuration from trees. The training area has about 40 % forest, which is maintained; a higher proportion than the Bundesrepublik. The training area BERGEN thereby contributes considerably to the climate stability. Long before the Lower Saxony water bye-laws were applicable to the training area, water conservation policy was practiced here. All the water on the training area

has such a good regeneration that one can drink from the streams without ill effect.
Because the water on the training area is artificially provided, through damming streams, care must be taken not to disturb the balance of nature. Marsh areas which have to be kept wet to prevent fires are, by use of meandering ditches, kept aerated to avoid stagnation. Moors catch fire easily because although the surface fire is extinguished, the fire reaches down into the peat underneath. Naturally the methods used in cities and industry are used here too. For instance all tank washdowns are equipped with oil filters; every bivouac area has a large rubbish container, regularly emplied. Each unit provides a cleaning detail of soldiers for removal of rubbish (cans, paper bags etc.) littered on the area. I maintain that there is not another area in Germany as optically and biologically clean as this training area.
Should an abandoned car wreck be deposited on the perimeter of the training area - within a week it will have been removed and scrapped. Near the Autobahn and in other public areas I know of wrecks that have been standing for years, without anyone bothering.

Now a final theme:
It has only indirectly anything to do with cultivation. It is noise abatement on the training area. This is, as you know, only a momentary nuisance with no long lasting effect on nature. Evenso the training area authorities try to keep it is minimal as possible by using belts of trees and placing firing positions in hollows. It is not possible to prevent it entirely. One should bear in mind during discussions that although it is a nuisance to people, it does not harm nature.
The Bundeswehr takes many measures to prevent environmental damage. Information leaflets are distributed down to Company level, so that company commanders can brief their soldiers. Posters and tables are supplied for notice boards giving information on how to conduct oneself in the environment; there are even training and instructional films on the subject. Every course at army officer's schools, i.e. all potential officers are given a guided tour through forest and flora, for at least half a day, by a forestry official who points out the co-existences in nature.

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Betr.: CCMS-Seminar in Soesterberg vom 28.11. - 30.11.1984

Thema: Protection of species and biotopes on MTAs.

The presentations of the preceding speakers (Col.v. Kohler and Director Lenz) have already made clear that military training areas in the Federal Republic of Germany accommodate a great variety of plant and animal species; they are valuable nature reserves.

One reason for this is, that our country is densely populated and open areas are used intensively for farming as opposed to the military training areas; a second reason is represented by the long-term efforts directed specifically at preserving training area terrain and at achieving a varied terrain structure.

To us as soldiers it is particularly important that the military use of a terrain alsofurthers the protection of the natural environment.

Let me now show specific examples of how we protect biotopes and endangered species; this will be illustrated with about 50 color slides.

1) Protection of Birds

- preserving hedges and variety of terrain
- old trees for birds that nest in caves
- setting up nesting boxes in woods and barracks
- openings for owls in barns and old buildings
- natural creek with kingfisher; modified creek - now a canal without life
- boards under swallows nests at barracks buildings
- no hunting of predatory bird

2) Protection of Bats

- undoubtedly one of the most endangered species of mammals, no vampire but a very useful insectivorous animal
- summer hiding places and winter quarters protected against intrusions with wire or other means.

3) Amphibia

- construction of marshy spawning pools with engineer digger
- armored vehicle trails temporarily closed, the ruts are used especially by natterjacks, mountain toads, salamanders as spawning ground - all of them protected species listed in our official red lists of endangered species
- even tank washing installations may become valuable spawning grounds for amphibious animals

Protection of Insects

- primarily concerns butterflies, which need "neglected" areas along roads and natural slopes where thistles and nettles grow, the plants that feed the caterpillars
- rare species of beetles also benefit from the untouched woods and fallow land on training areas, for example stag beetles, maibug.

Reptiles

On many dead furrows, on gravel-covered and on steep slopes, very often directly adjacent to ranges or armored vehicle trails, snakes and lizards can be found since these areas offer an intact habitat.

Protected Plants

of all genuses, even the most rare orchids, flourish on our training areas. Soldiers who are being trained as members of a recon patrol do not dig out or pick orchids. When building new roads or trails through forests, we must ensure that we do not destroy habitats of rare plants.

Every year, throughout the summer months, we offer guided tours and excursions to places of particular interest to biology on our training area to show the public that training areas are not necessarily destroyed terrain but can offer valuable habitats for plant and animal species,(cammon doormouse)in danger of extinction.

Our soldiers should be made more familiar with this secondary function of their training areas since only adequate knowledge and information can make people more considerate.

THE IMPACT OF MILITARY TRAINING IN CANADA ON INDIGENOUS FLORA AND FAUNA

Presented By: MGen J. A. Stewart
Mr. Anthony T. Downs

Research By: Ms. G. A. Stones

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Acknowledgements

We would like to express our appreciation to the personnel at CFB Shilo who were most helpful in the collection of research materials for this presentation. This presentation contairs significant extracts from the "Range Ecology Project, 1981" by J. M. McKernan and the "Environmental Guidelines for CFB Shilo" by W. E. Stevens and J. Carriero.

Impact of Military Training on

Indigenous Flora and Fauna

A Canadian Overview

Our first aim today is to share some of our experiences in the protection of wildlife and vegetation in our military training areas. By identifying issues and explaining how we deal with them perhaps we can provide some insight to you in dealing with your problems. Further, since we have bilateral agreements for training in Canada now, and perhaps there will be more in the future, it will be useful to know our situation. Our second aim is to learn from your research and experiences in order to apply them to our training situation in Canada.

To accomplish our aim, I will be giving an overview of the Canadian situation. My talk will be followed by Mr. Tony Downs who will give you a more detailed look at how we protect flora and fauna using Canadian Forces Base Shilo (and some other Bases) to illustrate and reinforce points as necessary.

The Department of National Defence for Canada has, over the years, set aside large tracts of land for tactical ranges and training areas. A list of the areas greater than 10,000 acres or 4,000 hectares is contained in Table 1. Because of the relatively remote settings of these areas, public concern about the management of the land and the potential for environmental impacts resulting from military use of the land is relatively new to us in Canada. Therefore, only very recently have any detailed studies been undertaken in Canada as to the effects our training is having on indigenous flora and fauna.

It has been the position of officials within DND that by and large, judicious use of training areas by the military has improved the situation for native vegetation and wildlife. This is partly a result of the protection afforded by restricted access to this land, but also because of the excellent communication between all levels of government. Federal, Provincial and Municipal authorities have cooperated to assist DND in the proper stewardship of the land. There are archeological sites on our training areas that have been preserved and that do not exist elsewhere due to cultivation or urbanization. However, some less obvious serious ill-effects are being experienced in some areas. An example of a negative side effect of training is the degradation of indigenous grass species and their replacement by faster regenerating species. This has occurred at Suffield where the native mixed prairie grass is being replaced by coarser, newer grasses; and in Shilo where native species are being replaced by coarse grass and noxious weeds. This may not be an immediate problem to the Base, but there is potential for the weeds to spread to surrounding areas and impact on the livelihood of farmers and ranchers.

The physical damage that is inevitable can be controlled through Range Orders but the attitude of the individual soldiers is important since their control of vehicles can make an exercise more or less aggravating to the environment. It is therefore necessary to persuade range users of the need to become actively involved in the protection and maintenance of the environment on military training areas, since, particularly in Southern Canada, these areas are the last refuge of many species of flora and fauna. All other land has been, or is being taken over by urban expansion, agricultural cultivation and cattle ranching.

Environmental protection is not, as you are well aware, cost free in terms of dollars. We are endeavouring, however, to ensure that the quality of training does not suffer as a result of protection measures. Where necessary we are willing to spend money for protection and mitigation rather than downgrade the quality of training. Thus, training area operation becomes increasingly expensive as more environmental constraints become necessary. That is not to say that all environmental concerns can be addressed. Damage is inevitable and some damage is irrepairable. That too must be considered as a cost of operation of military training areas.

Land use and land management has become an important issue in Canada. Even with the relatively large expanses of land that DND controls, we find ourselves under increasing pressure from local economic and recreational interests to make full use of our land subject to compatibility with military training. Examples of the type of activities that are carried on in conjunction with our training are:

a. oil and gas exploration at Suffield, Wainwright and Cold Lake;

b. cattle grazing at Wainwright, Dundurn and Suffield;

c. blueberry picking at Tracadie;

d. forestry at Petawawa and Gagetown;

e. hunting and fishing, including commercial fishing, in most areas.

Each of these non-military activities has its own impact on the environment and, in the case of adverse impacts, it is up to DND to resolve the problems that arise, assuming that the political situation will not permit the cessation of these activities. In fact, we must ensure that all other uses are assessed as to their environmental impact and then defend the activity to environmental groups even though the activity is completely

unrelated to the military mission. Very often we are criticized openly (in the media) for the potential adverse effects of the non-military activities much more than the normal military training activities.

Our responsibilities have been delineated for some time now. They are not overly restrictive and in fact give us maximum lacitude to operate in a responsible manner. Any new activities or changes in use must be examined for advance impact before proceeding. But it is the follow-up that is important; the observations and studies that assess the impact and recommend changes if necessary - the very thing that we are all here to discuss. Detailed studies have been carried out on wildlife and vegetation and these focused mainly on our Suffield and Shilo ranges where two of our NATO partners exercise regularly. Our case study is a compendium of the results of these studies and the recommendations made to preserve the soil, vegetation and wildlife. If anyone wishes more detailed information the study reports are listed in the Bibliography. I will be happy to see that copies are sent to you and if necessary contacts can be made with the authors of the reports.

TABLE 1

Training Areas Greater than 10,000 Acres (4,000 Hectares)

SITE	PROVINCE	USE	AREA	OWNED/ LEASED
Gagetown	New Brunswick	Army	273,528 Acres 109,411 Hectares 1,094.1 Km^2	Owned
Tracadie	New Brunswick	Air Weapons	44,572 Acres 17,829 Hectares 178.3 Km^2	Owned
Valcartier	Quebec	Primarily Army	52,657 Acres 21,063 Hectares 201.6 Km^2	Owned
Borden	Ontario	Land Training (Students)	20,000 Acres 8,000 Hectares 80 Km^2	Owned
Meaford	Ontario	Army	17,706 Acres 7,082 Hectares 70.8 Km^2	Owned
Petawawa	Ontario	Army	75,842 Acres 30,337 Hectares 303.3 Km^2	Owned
Shilo	Manitoba	Army Cdn/FRG	98,778 Acres 39,511 Hectares 395.1 Km^2	Owned and Leased
Dundurn	Saskatchewan	Army	57,592 Acres 23,037 Hectares 230.4 Km^2	Owned

SITE	PROVINCE	USE	AREA		OWNED/ LEASED
Cold Lake	Alberta	Air Weapons	2,873,734 1,149,494 11,494.9	Acres Hectares Km^2	Leased
Suffield	Alberta	Army Cdn/BATUS	643,840 257,536 2,575.4	Acres Hectares Km^2	Owned
Wainwright	Alberta	Army Cdn/Allied Forces	151,239 60,496 605	Acres Hectares Km^2	Leased
Chilcotin	British Columbia	Army	100,537 40,215 402.2	Acres Hectares Km^2	Owned

IMPACT OF MILITARY TRAINING AREAS IN CANADA

ON INDIGENOUS FLORA AND FAUNA

A Case Study - CFB Shilo

1. Introduction

Canadian Forces Base Shilo, which is situated near Brandon, Manitoba contains 14,400 acres of federally owned land and 84,378 acres of leased provincial Crown land. Since 1910, the Reserve has been used for military training of various kinds. In 1974, the Federal Republic of Germany and the Canadian Department of National Defence (DND) entered into an agreement whereby Germany rented large portions of the reserve for training exercises.

Every twenty-one days for the five month summer season each year, some six hundred troops are rotated onto the Reserve and trained in the use of the Leopard tank and the Marder Armoured Personnel Carrier (APC).

The use of this equipment along with the artillery exercises conducted by the Royal Canadian Horse Artillery, results in the carrying capacity of the ranges being exceeded by the load imposed. Damage to the plant cover has been sustained and soil has been denuded in some areas. Concern has been expressed by some members of the public that these training exercises are having negative effects on the wildlife and native vegetation in the area, and that these effects may be permanent and irreversible.

DND has a firm commitment to the protection of the prairie environment generally, and the CFB Shilo battle ranges specifically. The Federal Republic of Germany supports this commitment and contributes $25,000 per year to fund research studies assessing the effects of training on the wildlife and vegetation.

2. General Background

a. History

Geologically, the present military reserve sits upon what is known as the upper Assiniboine Delta. That delta was formed at a time when the Assiniboine River flowed into glacial Lake Agassiz at a point near the present city of Brandon. Since then the deltaic sands have been sorted and shifted by the forces of wind and water but generally the whole aspect of the old delta is that of a level and undulating plain with both active and stabilized sand dunes.

The Spruce Woods Forest Reserve was established in 1895 in deference to the opinion that the land was more useful for forestry than for agriculture, but over the years the level of forestry practiced has been superficial because of the sparse nature of the tree growth.[1]

In 1910 the Canadian Army began using the southwestern portion of the forest reserve for training, and in 1933 became established at Shilo. Most of the forest reserve east of provincial highway 258 has only recently been established as the Spruce Woods Provincial Park and there are public pressures to add thereto those portions of the military reserve containing the active sand dunes; the Bald Head Hills. Certainly the sand dunes are more scenic than functional from a military standpoint, and for some years military activity therein has been restricted to the use of light patrol vehicles.

b. Climate

The climate of the Spruce Woods area is continental in nature with hot dry summers and cold winters. The annual precipitation is less than 20 inches of which nearly half falls as rain during the months of May, June and July. Locally the nature of the topography has a marked effect on climatic conditions at ground level. North and east slopes of stabilized dunes are cooler and more humid than other exposures, or the level plains. This variation has prompted a varied vegetational complex, as will be detailed subsequently.

c. Soils

The parent materials for the soils of the military reserve are mostly deltaic sands and sandy outwash deposits. The deltaic materials are classed as loamy sands belonging to the Stockton Association of soils. Minicta sands to the south and east of Shilo are derived from glacio-fluvial outwash on level or slightly undulating terrain. All those soils are well drained and subject to wind erosion if the native mixed prairie vegetation is disturbed or broken. They are low in fertility with a weakly developed structure and rate very low, even for grazing use, on the agricultural capability map.

Large and extensive dunes have developed on the fine textured Stockton loamy sands, and active dunes and blow-outs are most in evidence, especially toward the east side of the reserve.

An interesting anomaly is the area of peat that lies in the valley of Epinette Creek on the northeast side of the reserve and

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1. W.E. Stevens and J. Carriero. Environmental Guidelines for CFB Shilo, Manitoba - A Report to the Department of National Defence from the Canadian Wildlife Service. Edmonton, Alberta June, 1973.

surrounds Sewell Lake. Eventually much of the peat zone will be covered over by infringing sand, but that probably will not happen within the present century.

d. Vegetation

The vegetation to be found within the military reserve is about equally divided between grassland, aspen parkland and a white spruce - aspen - bur oak complex. Each vegetation type is associated with particular soil and topographic conditions.

The grasslands on the sand plains have been described as being in a practically primeval condition, and until recently were little disturbed by military activities. The predominant prairie grasses were Stipa spartea and S. Comata, Andropogon Scoparius and Bouteloua gracilis.

e. Animal Life

Bison, pronghorn antelope, grizzly bear, black bear and the mule deer, no longer are found in the sand hills; although moose have maintained themselves in the muskey area along Epinette Creek, and elk have survived in the spruce aspen forest, protected by restricted access and provincial game regulations. The mule deer have been replaced by white-tailed deer and the latter have been hunted as game within the military reserve for the past few years. The preliminary Canada Land Inventory ungulate (hoofed animal) capability maps (1972) show the area to have limitations of moisture and soil fertility, which probably means that the existing populations of wild ungulates should not increase appreciably in the future because of those restrictions. Ruffed Grouse and Sharp-tailed Grouse also are hunted in the training area but the hunting pressure is low because of restricted access.

There are many species that I call the survivalists, that adapt to any condition imposed on them. They include: the coyote; Richardson's Ground Squirrel (known commonly as the prairie dog or gopher); the woodchuck; and the hare (or jackrabbit). It is the less conspicuous animal species that are more characteristic of the sand hill country, and some of them are found nowhere else in Canada. The Olive-Backed Pocket Mouse and the Southern Red-Backed Vole lead a more precarious life but are in no danger of extinction yet. The Northern Prairie Skink, a kind of lizard, is thought to be restricted to the Spruce Woods sand hills of Manitoba. The Plains Spadefoot Toad also is adapted to living in a semi-arid environment and has been found in the military reserve just east of Shilo. It shares that habitat with the western hognose snake,

which though not confined to Manitoba, is not abundant anywhere in Canada.

Shifting sands are home for a number of species of tiger beetles that have earned their name because of their predatory habits. They share the sand hills with an abundant fauna of grasshoppers that feed on the hardy plant life, and with bee flies and blister beetles that feed on the grasshoppers.

The bird life of the region is not particularly distinctive although, because of the variety of habitats, the list of species is long. Of particular interest are such uncommon species as ferruginous and merlin hawks, and the introduced wild turkeys, whose present status is in doubt. Greater prairie chickens at one time were found there but like the bison they have gone from the sandy prairies.

3. Problems Due to Training Exercises

As mentioned earlier the problems associated with military training exercises generally fall into three broad categories:

a. public concerns;

b. effects on vegetation and soil structure;

c. effects on indigenous wildlife.

These will each be addressed in light of the unique situation presented at CFB Shilo.

The mechanisms of damage are common to all military training areas; the major differences being the use/non-use of live weapons. The effects of the mechanisms must be looked at together to gain the proper insight necessary to develop correct remedial measures.

a. Explosives - devastation by impact and fire; danger from unexploded ordnance, blinds, etc.

b. Wheels/Tracks - compaction and furrowing;

c. Noise - aircraft, vehicles, firing of weapons, demolitions, impacts;

d. Movement/activity - vehicles, soldiers on foot;

e. Refuse/Waste - at bivouacs and along routes;

f. Herbicides - side or downstream effects of chemicals used to retard growth of larger plant species;

g. Non-Military Uses - grazing, oil exploration, hunting, etc.

The effects of all of these have not been studied in detail, but general observations can give some idea of their impact.

4. Public Concerns

At the time training exercises at CFB Shilo by NATO forces were first proposed, some concern was expressed by members of the general public and special interest groups. Most of that sentiment was directed toward the dune areas, specifically the Bald Head Hills on the east side of the reserve. Increased public access was provided by the construction of a highway, and increased public appreciation of the sand dunes had grown in proportion.

The area has been called Canada's only true desert, and such organizations as the Manitoba Naturalists Society championed its protection and preservation. In addition, a major portion of the open dune country had been proposed for preservation as a terrestrial community under the International Biological Programme (IBP). That program, supported by the International Council of Scientific Unions, is world wide and its aims have, as you know, widespread acceptance among the scientific community. Another I.B.P. site of about two square miles has been chosen on the mixed grass prairie along the western edge of the military reserve, and an alternative site of larger size along the southeastern boundary. Those proposed reserves were intended to maintain under natural conditions a portion of the vegetative community of the dry sand plains.

The public were also concerned that the increased military activity in the Reserve would result in loss of access for both consumptive activities such as hunting and non-consumptive activities such as recreational pursuits.

In order to address these concerns and to reflect DND's commitment to the protection of the environment, the Shilo Environmental Advisory Committee (SEAC) was established. The Committee is composed of federal and provincial representatives and meets semi-annually to review programs and make recommendations to the Base Commander.

SEAC advises the Base Commander on methods of using the military reserve in such a way as to minimize environmental impact. They recommend environmental monitoring procedures that should be followed in order to

provide early detection of environmental degradation, and they advise on methods of repairing environmental degradation, and coordinate all resource management projects and resource studies undertaken in the area. SEAC also acts as liaison committee for DND, Environment Canada and the Manitoba Department of Mines, Resources and Environmental Management; Renewable Resources and Transportation Services; and Tourism/Recreation and Cultural Affairs.

In this way, the concerns of the public and interested private sector are addressed in a responsible organized manner and all parties' views are openly considered and actioned where appropriate.

5. Effects of Training on Vegetation and Soil

The use of fixed Battleranges (Ranges) for tanks and APC exercises at CFB Shilo has presented some problems related to vegetation and soil maintenance. A brief description of the ranges and how they are used will assist in understanding the underlying problems.

Ranges vary in size from approximately 80-100 hectares and are named Aachen, Berlin, Cologne, Deilinghofen and Essen. The areas (areas) used to stage artillery exercises are sporadically used, and disturbance is confined to relatively small (approx. $900m^2$) sections. All areas and ranges are flat except for Essen, where small indulations are typical.

Within the Ranges, tracked vehicles proceed from fixed marshalling areas (parkplatzes), towards the "startline", along which length they are distributed at random intervals. Moving in uison and roughly parallel to each other down the length of a Range, tanks and A.P.C.'s fire a variety of ordnance at fixed and "pop-up" targets of various sizes. Practice 105 mm anti-tank and anti-personnel ordnance and 7.6 machine gun fire are directed at targets. Tank-mounted phosphorus mortars may occasionally be used and impact into the target areas. All vehicles, including rubber-wheeled safety vehicles, return to the parkplatz by designated dirt roads.

A recent study[2] prepared for the Shilo Environmental Advisory Committee detailed the effects this type of training was having on the various Ranges.

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2. J.M. McKernan. Range Ecology Project - Final Report. March, 1981.

It found that three trends were apparent on all Ranges but in varying degrees. They were as follows:

a. significant and consistent reductions in frequency and cover of desirable native species;

b. increased soil compactions, and

c. evidence of encroachment of undesirable species such as Euphorbia esula (Leafy Spurge). Leafy Spurge is a noxious weed which was introduced to Western Canada from Europe and has become well established and is spreading rapidly.

The result of reduction of plant cover is either erosion or replacement with undesirable species. Erosion occurs quickly and catastrophically on the Canadian prairies. In the sandy soil blow-outs occur changing the landscape and the ecosystem in the immediate area. Blow-outs can, of course, occur naturally but with decreasing incidence as nature stabilizes dunes with vegetation.

The report went on to recommend measures to mitigate and monitor the stress that was increasingly becoming evident on the Ranges. It recommended reduced activity on the two Ranges which showed significant stress, a land use plan to include harrowing and two year protection for those large areas of damaged Ranges and, where a two (2) year rest is not feasible, the use of seed mixtures and fertilizers to aid recovery of the vegetation. The harrowing and resting were found to be more effective in restoring native vegetation. General range management practices employed to minimize vegetation and soil damage include the use of designated routes rather than indiscriminate travel, minimization of power turns where possible, reduction of deliberate range burning , emphasizing fire suppression activities, and rotation of training areas. The training start has been delayed until early-season perennials can establish growth. DND has also agreed to restrict all vehicular traffic in the Bald Head Hills, Epinette Creek, Deilinghofen IPM site and any such area which is agreed upon from time to time in order to protect areas of particular ecological value.

In order to investigate and attempt to control the problem of encroachment of unwanted species, DND has agreed to establish a noxious weed program and will include specific reference to the control of Leafy Spurge. This is a measure to protect remaining native vegetation and domestic livestock (cattle). Researchers have indicated that biological control of Leafy Spurge may be a practical method of control. This system can utilize insects or pathogenic microbes specific to the spurge. More research is required to confirm that the control does not have adverse effects on desirable species. Reports on attempts at biological control in eastern

Europe (the origin of Canada's spurge species) have been difficult to get; thus, we are currently operating on our own without benefit of this experience. If delegates at this conference can assist in this I would be grateful to discuss it with you.

The use of herbicides is not great at CFB Shilo and perhaps only sufficient to retard the spread of Leafy Spurge. At other sites we are faced with spraying large tracts of land to stop tree and bush growth to maintain adequate battle runs and manoeuvre areas; this after having clear-cut an area out of prime forest in the first place. Thus we are forced to destroy certain plant species and, therefore animal habitat, to meet the military aim. This would be serious at CFB Shilo and other prairie sites since there is little or no alternative habitat for the animals. However, there is sufficient open country at these military sites to permit all vehicles.

The plant/animal interface is, of course, crucial to most species and so one cannot be preserved without the other. Changing of river courses to create watermanship training areas has altered marsh areas downstream. Spring floods which act as a cleanser and rejuvinator for the swamp plant life are reduced. The drowned plant matter becomes nutrients for minute animal life and other plants and so re-builds the food chain. This has just been recognized at one base and spring release of water with a resultant delay of training start-up may have to be entertained to return to a more normal ecosystem.

One river at CFB Petawawa in eastern Canada is being excessively silted by vehicle fording resulting in disappearance of some fish species. This is a matter of choosing better crossing areas and keeping vehicles in prepared approaches. This lesson recently learned will have to be considered at CFB Shilo where a new watermanship training area is required.

6. Effects of Training on Wildlife Species

As mentioned previously, the CFB Shilo Reserve is an important natural habitat for a wide variety of wildlife. Because of this, SEAC and the Federal Republic of Germany have taken a special interest in promoting and funding research on the activities of a number of species, and the effects that military training could be having on these species.

Of particular interest is the intensive research program that has been carried out on the resident elk population. The indigenous elk herd gradually died out during the late 1800's probably due to pressure from

agricultural land use and over-hunting. They were introduced to the Reserve area around 1917 and populations have shown a steady increase since.

Concern had been expressed that the unused portions of the Reserve were important as "sanctuaries" for elk from at least certain types of military training. SEAC recommended research be undertaken to determine the present situation concerning the herds and projections for the future.

This study[3], completed in 1981 determined that the military training was not detrimental to the elk population, but was actually beneficial. It was found that new habitats were opened up by the training exercises and that the animals had adapted quite well to the use of the land by the military. The study speculated that the elk had adapted to where they would only migrate from the Range areas during the time of intense military activity and return when firing had ceased. Animals were observed in the impact areas during periods when no firing was in progress, an indication that these areas are not avoided at all times.

Another reason the elk population may have increased is that losses due to poaching and Treaty Indian harvest have been reduced because of the restricted access to the Base. The growth in the population has been significant enough in the past twelve years to have allowed a controlled hunt each year since 1979. This type of hunt has been very favourably received by the general public and wildlife management personnel.

Other studies have been undertaken to investigate species of particular interest to local wildlife specialists. These include the Western Hog Nose Snake (Heterdon nasicus), the Northern Prairie Skink (Eumeces s. septentrionalis) and the Sharp-Tailed Grouse. It has been speculated that for some native bird species, the military activity is less disruptive than the alternative land uses common in the area such as ranching and farming.

To date, measures to preserve wildlife have been limited to creating out of bounds areas, such as the Bald Head Hills area, or seasonal avoidance of calfing and resting areas and, in particular, wintering areas. Corrective or mitigating measures to ensure that protection of native fauna are considered by SEAC as required when studies, or observations, indicate there is a potential problem.

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3. John Thomas Strong. Distribution, Range Use and Movements of Elk on the Shilo Military Reserve. Natural Resources Institute, University of Manitoba, Winnipeg, Manitoba, May 1981.

SUMMARY

7. The Canadian Department of National Defence has long recognized the need to consider the effects that training in sensitive environments such as CFB Shilo may be having. The establishment of the Shilo Environmental Advisory Committee is evidence of the commitment to striking a balance between their activities and the protection of the local ecology.

DND is drawing on the experience gained at CFB Shilo and on the other Canadian Bases which support training exercises in the establishment of a new training area in Southern Alberta. Approximately 10,000 acres is being considered for this range but prior to its development, an investigation of the potential impacts that the training could have on the local flora and fauna has been undertaken.

It has been established that for this area and for other similar areas proposed in the future, Terms of Reference for the Ranges will include a range monitoring program which will monitor troop activities and recommend immediate remedial measures should problems arise.

Over the years DND has received the support and assistance of Federal, Provincial and local environment personnel and allied co-users in its efforts to consider the ecological dictates of an area, while maintaining its effectiveness in its primary role.

Essentially the measures taken to preserve flora and fauna in Canada are:

a. Advisory committees to Base Commanders;

b. Avoidance of specific areas of concern/designated routes;

c. Rotation and resting of areas of use;

d. Re-planting;

e. Inventories of flora and fauna;

f. On-going research studies;

g. Variable seasonal start times;

h. Chemical and biological control of undesirable species;

i. Supervision/control of vehicle manoeuvres;

j. Fire protection/suppression measures.

8. Conclusions

a. We can co-exist with vegetation and wildlife, albeit the vegetation must be compatible with our role as the former trees in CFB Gagetown could witness.

b. We consider the setting up and on-going advice of an environmental advisory committee for training areas to be essential to the long term protection of flora and fauna as well as our occupation of an area. It is the first and most important step in the process of co-existence.

c. Detailed periodic inspections of vegetation and wildlife should be done. Any new apparent discrepancies should be further investigated, especially where rare or endangered species are involved.

d. If military training is found to be a causal agent mitigating measures should be sought. If no mitigation is possible then it is decision time - train or not.

e. Mitigating measures are the same the world over except in Canada we have one option that may be more practical. That is the rotation and resting of distressed areas that is possible due to the size of our training areas.

f. Some damage to the environment must be expected and accepted. Everything cannot be mitigated. We must protect as best we can . but, a tank and a deer cannot occupy the same square metre of grass at the same time. Good range management can ensure that they both get equal time and that the square metre is useable by both. That is, the plan should attempt to reduce the conflict.

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MULTIPLE USE OF MOD PROPERTY FOR SERVICE REQUIREMENTS, AGRICULTURE AND CONSERVATION AND ACCESS FOR THE PUBLIC

C. N. Clayden
Ministry of Defense, United Kingdom

1. I am The Ministry of Defence (MOD) Conservation Officer and am responsible for the Wilflife Historical and Scientific sites and environmental aspects on the 600,000 acres (242915 ha) of the MOD estates.

2. My aim is to establish enough knowledge about each site to enable me tc provide a conservation input in a long-term Management Plan which is designed to satisfy the needs of the Services, Agriculture, Conservation and Access for the Public.

3. This entails:-

a. The surveying and recording of all Wildlife, sites of historical and scientific interest and the monitoring of such records.

b. The preparation of a Vegetation, Archaeological and Sensitivity Map.

c. The formulation of management proposals for the particular site.

d. Implementation of management proposals.

e. Liaison national and local level.

f. Education of Service personnel and Public. Films, Talks, Publications, Exhibitions and Field Meetings.

g. Deer Management.

4. STAFF

One Assistant and a Clerk.

5. IMPLEMENTATION OF TASKS

a. I have no additional money or labour so have to resort to means of persuasion of the public and Services to assist. I have 193 sites under surveillance with about 180 Conservation Groups.

b. The composition of the Groups is as follows:

(1) Chairman — Service Authority of Site

(2) Committee

(a) Botanist
(b) Ornithologist
(c) Entomologists
(d) Archaeologist
(e) Deer Manager

) Representatives of main interests on site Additional helpers coopted by Sub-group leader in the various activities

(3) In attendance

(a) Estate Surveyor /Ground maintenance Staff

(b) Nature Conservancy Council

(c) MOD Conservation Officer.

NB Local County Trusts, Natural History Societies if not represented by any of the above should have separate representation.

(4) These are all Volunteers and are invited to assist the MOD in this work. They number some 4000 people of which 85% are Civilians.

6. Lets take a few examples of sites and how the system works.

a. CASTLE MARTIN. 6000 acres (2429 ha)

(1) Located in Wales.

(2) Tank Training Ranges, Helicopter Firing and Infantry Trg. RAF.

(3) Military Training. A number of Tank Battalions train from April to November. Ranges fully used. A long and short battle run provided. No firing during Lambing in March/April.

(4) Agriculture. October to March main Military training ceases. 12000 Sheep 500 Cattle move down from the Welsh Mountains for winter keep. They return after Lambing. 5655 acres used all told.

(5) Conservation. This management has made very little alteration to the habitat in the last 20 years.

(a) BIRDS. An Important BIRD Sanctuary 86 Sp recorded with 52 Breeding including Peregrine, Raven, Chough, Large Sea Bird Colonies. Important migration route.

(b) PLANTS. 322 Species recorded to date. with 94 Sp of Lichen.

(c) INSECTS. Butterflies 21 Sp. Moths 182 Sp. and Dragon/Damsel Fly 11 Sp.

(d) FAUNA (less Birds) Important site for Bats including the Greater Horseshoe.

(e) HISTORICAL SITES. A number of Barrows and Camps

Flimston Chapel Medieval
17th Century Farm House.
Iron Age Fort 700 - 43 BC

(6) Access

(a) Car Park for 150 Cars.

(b) Picnic Area on Cliff.

(c) Cliff Walk of 2½ miles from centre of Range to Eastern Boundary.

(d) Ranges open most evening and weekends, also the whole of August and part of September.

Local authorities maintain Car Park and Picnic Area.

b. STANFORD PTA 17000 acres (6883 ha)

(1) Located Norfolk. Eastern England Breckland

(2) All Arms Training less Tanks. 85,000 Troops annually. Live and dry Training areas.

(3) Agriculture

(a) 15 Tenant Farmers (Two full Agriculture Tenants)

(b) Arable 2500 a. 1012 ha.

(c) Grazing 9.582 3979 ha 10000 Sheep

(d) Forestry Commission Woodland 1633 a. 661 ha

(e) MOD Woodland 1920 a. 773 ha

(f) Nursery for Trees for Transplanting

Total = 15,635 6329 ha

(4) Conservation

(a) Plants 637 Species 28 rare or uncommon

(b) Birds 137

(c) Moths 331

(d) Butterflies 31

(e) Freshwater Fauna 152 4 Extremely Rare 1900-1890

(f) Mammals. All six Species of Deer.

(g) Archaeology

(i) 4 Churches. Norman/Saxon.

(ii) 23 Listed Ancient Monuments.

(iii) Neolithic sites 3000-700 BC.

(iv) Burial mounds.

(v) Peddars Way Roman Road.

(5) Access

(a) 300-400 permits for local people to move through range from house to place of work.

(b) 40 permits for Naturalists.

(c) 10-15 Societies visit each year and are given a conducted tour.

c. Shoeburyness. 34810 acres 14093 ha

(1) Located Essex East Coast of England Northside of Thames Estuary. 28,000 of total acreage foreshore.

(2) Military Use Research and Development. Gun Range Restricted Access. No cameras.

(3) Agriculture Six Farms - some of the finest arable land in Britain - Record crop bearing. Some grazing.

(4) Conservation

(a) Plants 229 Sp 13 rare, 8 uncommon

(b) Birds 238 Sp recorded over last 80 years.

(i) Brent Geese. First land fall in Britain. Total in November 17000-14000. 1/6 total worlds population.

(ii) Little Tern. Largest colony in Europe 306 pairs, thats 10% of British population and 5% of European population.

(c) Insects

(i) Butterflies 15 sp

(ii) Spiders 18 sp

(d) Historical sites. Group has own mobile Exhibition of Roman and Medieval artifacts - renovating a 19th century farmhouse as Conservation Centre.

(5) Access A number of people live in the area and have passes to leave and enter. In addition some 40 Naturalists have access.

7. SUMMARY

Having ascertained the Military requirement, the percentage of activity of each of the other activities will depend on the type of Military activity. Safety and Security and the status of the land soil. These matters are sorted out within the Conservation Groups. It is the Military authority who has the final say.

Integration of NATURAL RESOURCE Conservation, Environmental Protection, and TRAINING REALISM on U. S. Army Installations

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Part I. Overview of Natural Resource Program on Army Installations

This report will be based on programs presently in place to conserve and manage natural resources on U.S. Army installations, although similar programs do exist within the entire Department of Defense. This fact is evident as the technical manuals (TM) currently prescribing natural resource responsibilities were developed and instituted by the Departments of the Army, the Navy, and the Air Force[1].

The U.S. Army owns or leases approximately 12,000,000 acres of land within the United States and its territories. While the primary mission of this land is to support military training there is a secondary mission of multiuse programs, and conservation of natural resources. Before going into specific programs to protect flora and fauna from, or during, military training I would like to describe the natural resources management programs as they are detailed in these technical manuals and give an overview as to installation responsibilities.

There are two major revenue programs within the Army that annually return millions of dollars to the U.S. Treasury. First, forestry programs vary from standard timber/lumber harvest programs to fence post and firewood for household use programs. All forestry programs are provided for in TM 5-631, Forest Management, which includes guidelines for timber inventory, timber sales and harvest, and silvicultural practices.

The second major revenue program is agricultural outleasing. This program leases land to local farmers and ranchers and includes grazing, crop production, and haying contracts. This program is briefly discussed in TM 5-630.

A percentage of the funds raised under these two programs are returned to the installations to upgrade their agricultural or forestry programs and a small amount is also devoted to research in these specific areas.

A third, but smaller, revenue program comes from the Fish and Wildlife program. Most installations have a permit sales program for hunting and fishing. These funds provide some support to the fish and wildlife management programs but the primary benefit of the program is providing recreational opportunity to military and civilian post personnel or the local civilian populace when security and safety does not present any difficulties.

Protection of Endangered Species and the management of fish and wildlife habitat is also the responsibility of Fish and Wildlife program. Almost every major U.S. Army installation is either inhabited by an endangered or threatened species at sometime during the year or has within its boundaries areas that are considered to be critical or regionally unique habitats. Generally Army training and related activities are detrimental to endangered species and critical habitats. Even natural resource management programs such as forestry, agriculture, and recreation can be detrimental. However, there are occasional exceptions where survival has actually been enhanced due to military training. Kirtland's Warbler nests only in areas where the habitat is continually disturbed and stays in an early successional stage, a situation common to Army installations within its range (Camp Grayling). Another example is the Red-Cockaded Woodpecker which requires old, living, diseased, pine trees for nesting. These trees are provided around firing ranges where

trees are not harvested because of potential damage to saw blades by imbeded bullets and shrapnel. This incidental damage also increases the frequency of red heart disease, the disease usually found in nest trees.

Also under the Fish and Wildlife program is the control of pest species and the management of non-game species.

Under the umbrella of natural resources management program are two somewhat related management programs; outdoor recreation and archeological and historical site preservation.

Outdoor recreation includes many areas of interest but here we are concerned primarily with those that are related to use or modification of the natural vegetation or terrain. The natural resources of a military training area can provide many recreation opportunities such as hiking, horseback riding, camping, and off-road recreational vehicles (ORV's).

Archeological and historical resources are not renewable and therefore create a different problem in the realm of natural resource management. All installations are required to identify, categorize and preserve sites that may be considered of significant value. These areas must be off-limits to training.

Part II. How the Damage is Done

Natural Resource management programs as previously described have been a part of the U.S. Army's program in one form or another for decades. But shortly after passage of the National Environmental Policy Act in 1969 (NEPA) and Army Regulation 200-1 (AR 200-1) on Environmental Quality, Environmental Protection and Enhancement, and its predecessors, the U.S. Army began to study the cause and effect relationships between its training mission and the environment in which it trains. Most of this damage is intuitive but the problem was documenting this intuition, determining the analytical correlation of change, and then developing a program or series of programs to mitigate these effects to the degree possible.

The first major problem to be studied, and the one furthest along, is the damage caused by tactical (tracked and wheeled) vehicles as they maneuver cross-country[2].

The primary stress point is physical damage to vegetation which injures or destroys the vegetation. The second level of vegetational damage is that done by crushing root systems while maneuvering close to the tree but not touching the above ground canopy. Another type of damage is that done by camouflage. Whether it is the cutting of limbs or the positioning of a vehicle leaving a permanent scar on the landscape. In one case, Fort Carson, CO, these trees are approximately 200 years old and cannot be quickly replaced.

Another common damage is that done to the ground cover and soil surface. While this does not detract from the immediate use of the land for training, if the problem is not corrected training can be effected by increased water-borne and airborne erosion.

When the vegetation and soil are damaged a secondary impact could be to

the local water quality due to runoff, or to the animal life due to habitat alteration. The animal community can also be effected by disturbing behavior patterns such as breeding, nesting, denning, hibernation, aestivation, feeding, etc.

Two other effects of training are the use of smokes and obscurants and prairie and forest fires started by tracer munitions, during bivouac or careless disposal of cigarettes.

The list of other damaging factors is extensive and includes such items as meal and beverage containers; oils, fuels, and lubricants spilled during field servicing or leaking from damaged vehicles; and spent ammunition casings and carrying containers.

These are the effects of maneuver training. The effects of weapons firing training (firing ranges) is an entirely different problem that I will not cover except to say that ranges are smaller in total acreage and under far greater control.

The United States has a great variety of ecosystems ranging from desert to subtropical in humidity and rainfall and from northern coniferous forest through the open prairies and deciduous woodlands to the southern coniferous forests in vegetation types (Table 1). Major training facilities are located in each variant and the extent of impact is highly variable and dependent upon the resiliency of the system (Figure 1).

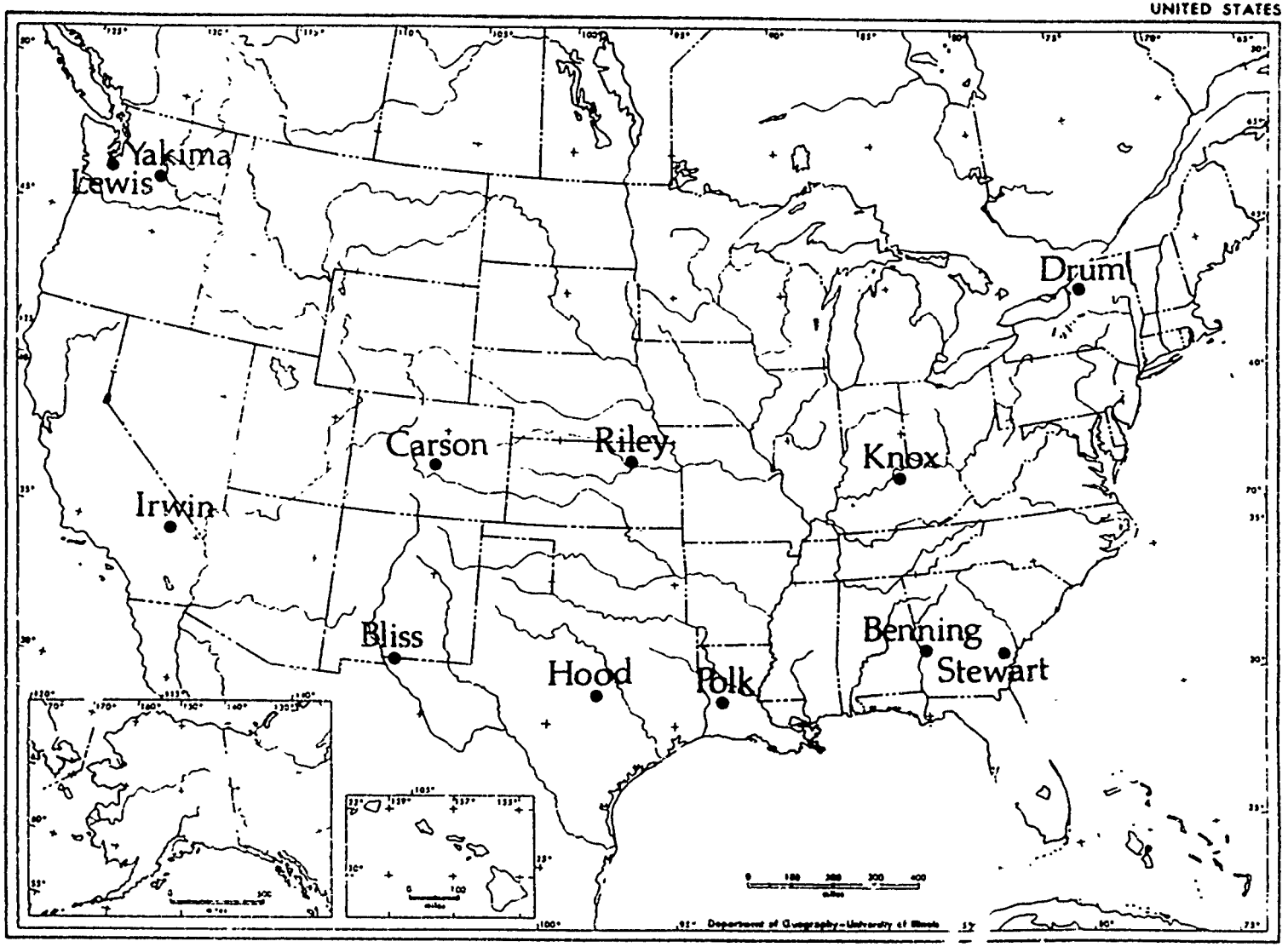

Figure 1. Locations of the installations studied.

TABLE 1

U.S. Army Installations Studies and their Ecological Region

Fort Lewis - Northern Coniferous forest and gravel moraine prairie

Fort Drum - Ecotonal area of Northern coniferous and Eastern Decidous woodlands

Fort Knox - Eastern deciduous forest on a Karst topography

Fort Riley - Ecotonal area of tall grass prairie and deciduous woodland

Fort Hood - Short grass prairie and decidous shrubland

Fort Carson - Short grass prairie and coniferous shrubland

Yakima Firing Center - Short grass prairie

Fort Benning - Southern coniferous forest

Fort Stewart - Southern coniferous forest

Fort Polk - Southern coniferous forest

Fort Bliss - Desert

Fort Irwin - Desert

Twelve installations were selected in the early phases of our research as representing different types of training programs (TRADOC (basic) versus FORSCOM (advanced unit/readiness) and different ecosystem variations. After initial visits four installations (Polk, Knox, Hood, and Lewis) were selected for detailed cause/effect, studies, although similar detailed studies have now also been conducted on Forts Irwin and Carson.

From these sites a large amount of mammal, bird, vascular vegetation, and soils data was collected and analyzed.

From this work a series of technical reports, journal articles, predictive computerized systems, site selection guidelines, technical manuals, engineering technical notes, slide presentations and videotapes have been produced.

Part III. Training Area Maintenance

Over the past few years a research effort has been underway to develop technologies to help U.S. Army installations to better maintain their environment[3]. The basic approach has been in the form of three thrust areas: Rehabilitation and Maintenance; Management, Planning, Decision Support, and Scheduling; and Education/Communication.

The first thrust area has an ecosystem variability problem. To date our work has been primarily in the arid and semi-arid regions. The first task has been to develop rehabilitation and maintenance prescriptions that will revegetate and stabilize the soil on already damaged lands. In the United States a considerable amount of information was available for seed-bed preparation, fertilization, and suitable plant species for semi-arid areas but their purpose was to return the land to a monoculture grassland to be used primarily for cattle grazing. A second purpose was to stabilize soils in strip mining areas. The information was not completely useful for areas that needed to be returned to a reasonably natural condition to promote realistic training. To address this problem an eleven species seed mixture was developed that included native grasses and shrubs. The prescription for planting included chisel-plowing, fertilizer application, seasonal timing of broadcast and rangeland drill seeding, and a program to monitor the prescriptions effectiveness.

The management, planning, decision support, and scheduling thrust has taken a broad approach. Some of the research products currently being used are the Environmental Early Warning System, Mobilization Facility Planning System, and Stationing Analysis Model which deal with the locationing and relocationing of U.S. Army units during both peacetime and under mobilization. The Geographical Information System is an installation specific system that

displays, using computerized color graphics, the installations resources, topography, vegetation types, soil types, ranges, power lines, highways, railroads, etc. This can then be used to assist in the decision processes and planning for the post.

It is under the area of management, planning decision, support, and scheduling that a unique concept for training area maintenance is being developed, tested, and demonstrated. The concept is mini- or small-area rotation. Vehicle damage is so extensive, and land use for training so intensive, that to rest large parcels of installation lands during the critical growth periods was not possible yet continued training negated much of the benefits of revegetation programs before the plants were adequately established. The following slides will show the concept.

The delineation and scheduling of these small areas to integrate with the training mission and the land management mission requires planning and good communication. We refer to the (small-area) mini-rotations sites as Management Scheduling Units (MSU's). To eliminate fencing either natural or permanent man-made boundaries are used. Examples are waterways, topographic changes, vegetation changes, roads, and railroads. It is also important that the areas be kept small and well separated from each other so as to not impede training.

Presently a commercially available software package is being used for scheduling and the use of geographical information systems are also applicable. Whatever an installations decision on scheduling and management systems it will have to involve a complex of monitoring, natural resource management goals, and training uses.

The final thrust is that of education, communication, and environmental awareness. The education program as it has been developed for Fort Carson consists of:

> Natural resources slide show directed at informing military personnel on the value of land as a natural, and training, resource,
>
> gloom and doom slide show depicting how severe damage is from training maneuvers,
>
> a videotape combining the aspects of both slide shows plus a description of the right way and wrong way to train.
>
> The rest of the materials are posters, stickers, and T-shirts

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TM 5-631, Natural Resources Forest Management, Dec 1981
TM 5-633, Natural Resources Fish Wildlife Management, Feb 1982
TM 5-635, Natural Resources Outdoor Recreation and Cultural Values, Feb 1982.

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TR N-124, Application of the Recreation Opportunity Spectrum for Outdoor Recreation Planning on Army Installations, March 1982.

TR N-134 Endangered Species on U.S. Army Installations, Aug. 1982.

TR N-139 An Overview of Potential Methods for Maintaining Training Area Environments in Arid and Semi-Arid Climates, April 1983

TR (in press) Annotated Directory of Endangered Wildlife on Selected U.S. Army Installations West of the Mississippi River.

TR (in review) Plant Species Suitable for Vegetative Stabilization of Training Lands in Arid and Semi-Arid Environments.

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Fact Sheet

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INTEGRATED TRAINING AREA MAINTENANCE (ITAM)

Increases in training, complicated maneuvers that must be repeated frequently, and heavier vehicles have made environmental considerations, resource conservation, and the need to maintain realistic training areas crucial training area management issues. These issues must be dealt with to ensure that the Army accomplishes its training missions. Efforts to date have failed to take an integrated, broad-based approach to solving these problems, focusing instead on causal factors and dealing with problems in a piecemeal fashion.

The U.S. Army Construction Engineering Research Laboratory (USA-CERL) has developed a comprehensive training area maintenance program to solve these new land management problems. The five part ITAM program is being demonstrated at Fort Carson, CO, as part of the Facilities Technology Application Tests (FTAT) program.

Part one, rehabilitation and maintenance, goes beyond current soil stabilization and revegetation techniques. Instead, ground covers of native grasses and shrubs are planted using various seedbed preparation techniques. Species selection is based on: (1) ability to withstand the effects of vehicular traffic, (2) suitability for providing tactical concealment, and (3) contribution to creating as natural a training environment as possible.

Part two, rotational scheduling, is based on new, small area rotation (or mini-rotation) principles. Only severely damaged areas requiring undisturbed rehabilitation are rested and their size is generally limited to 250 acres. Contiguous areas or areas located close to each other are not rested simultaneously to avoid interfering with training activities. Signs, topographical features, drainage ditches, roads, and large structures are used to delineate rested areas; no fencing is required. At Fort Carson, a 9 square kilometer area, including an 80 acre mini-rotation site, is being used to demonstrate the benefits of rotational scheduling.

A multi-media environmental awareness program, part three, takes an approach similar to the "Litter Bug," or "Pitch In" programs. The program emphasizes practicing environmental conservation during training. Videotapes, slide presentations, posters, stickers, circulars, and T-shirts introduce officers, enlisted personnel, and civilian employees to an installation's natural resources. More importantly, the program shows how training areas can and have been damaged or destroyed, and that much of this destruction is unnecessary. Periodic press releases reinforce the educational program and

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TRAINING AREA RESEARCH/BASIC

To adequately maintain U.S. Army training lands requires knowledge of the cause/effect relationships between training and environmental degradation. The basic mechanisms leading to vegetation reduction, erosion, and loss of other natural resources have not been adequately determined or quantified.

To address this problem, CERL initiated a research program which generally determined pre- and post-training conditions in four major ecosystems: oak-juniper woodlands, moraine prairies, deciduous woodlands, and southern coniferous forests. Parameters studied were song birds, small mammals, vascular vegetation, and soil. This research showed that as a result of training activities, woodlands are opened, understory is reduced, surface soil and duff is lost, food resources are lost, and there is a general loss of animal and plant biomass. A continuing effort is being directed at determining rates of change and the biological interrelationships between plant and animal groups.

The second problem requiring basic research was how to extend the information obtained from one installation ecosystem to other ecosystems without detailed, installation-specific studies. To address this problem a relatively new concept of organizing animals and plants into what are referred to as guilds was modified for applied studies. A guild, by simple definition, is a group of organisms that use similar resources in a similar manner. In applying this concept to environmental analysis the definition was modified by adding, "therefore an action that affects a guild in a certain manner will affect all members of that guild similarly."

Use of the guild concept in environmental analysis will drastically reduce the collection of field data necessary for both preproject planning and ecological and environmental condition studies. This will allow data gathered to be used both within and between ecosystems thereby reducing ecosystem variability problems. This information will allow project managers to more effectively list by priority the methods necessary to lessen the environmental impacts of a project early in the planning phase. The inherent advantage is that proper procedures to reduce adverse environmental effects can be predicted before project initiation, allowing the methods to be implemented through a timely and more cost-effective program.

These two basic research efforts are being directly incorporated into both the training area prediction and maintenance projects currently underway at CERL.

CERL POC is Dr. William D. Severinghaus, COMM 217-352-6511, Ext. 420; FTS 958-7420; AUTOVON through Chanute AFB; or toll-free 800-USA-CERL (outside Illinois), 800-252-7122 (within Illinois).

HABITAT EVALUATION AND MANAGEMENT IN THE MILITARY TRAINING SETTING

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INTRODUCTION

The Environmental Laboratory is one of the U.S. Army Corps of Engineers Research Facilities located at the Waterways Experiment Station (WES) in Vicksburg, Mississippi, USA. Many of the laboratory's research projects deal with vegetation, wildlife management, land use and natural resource planning. This paper presents information on habitat evaluation and management in military training areas and is divided into two parts: 1) new technologies and 2) the application of these technologies in the development of a model land use plan for training areas.

NEW TECHNOLOGIES

Wildlife Management Manual. One of the civil functions of the Corps of Engineers is to manage nearly 1.7 million hectares of land. These lands contain water resource projects authorized for flood control, hydropower, and navigation. Most are managed to some extent for wildlife. Corps projects frequently present the type of management situations encountered at training sites. An example is the management of disjunct or oddly-shaped parcels of land, or the requirement to serve a variety of purposes in addition to wildlife.

A wildlife management manual is being developed to meet the Corps' special needs (1). This manual will also meet many of the wildlife management needs on military training areas. It is divided into a series of chapters that give detailed information on commonly managed species, desirable wildlife plants, nursery and planting requirements, equipment specifications, and wildlife management prescriptions. It will provide the land manager with a detailed resource document for wildlife management that is directly applicable to training lands.

Wildlife Habitat Evaluation. An important part of wildlife management is the ability to accurately measure the resource. The Corps and the U.S. Fish and Wildlife Service (FWS), have been testing the FWS system for wildlife habitat evaluation. That system is known as the habitat evaluation procedure, or HEP (2).

HEP is a method for documenting the quality and quantity of habitat for selected species. The user decides which species are the most important -- for economic, sporting, ecological, or whatever reason. The area is then cover typed, and a model of the selected species habitat requirements is applied to each habitat type. The result is a rating of 0.1 to 1.0 for the area in question for each species selected for evaluation. The rating is called the habitat suitability index. The individual ratings are multiplied by the size of the area to give habitat units, which are the common basis for comparing habitats. WES has been applying this technique on military training sites for several purposes: to establish baseline conditions; to determine the relative importance of different areas to selected species; and to identify those habitat factors that are limiting to the success of animal species. The most important application of HEP to military training areas is that it provides a way to quantitatively establish the value of an area to wildlife, and measures the impact of training and the success of management.

Erosion Control. Maintaining soil integrity is often the key to successful management of plants and animals. Proper agronomic and agricultural procedures have been applied routinely in low to moderate risk areas; however, many soils present special problems when the vegetation is removed or disturbed by training activities. We have recently completed two manuals that should be of great value in these situations. One deals with soil erosion control procedures and revegetation of problem soils -- soils that are highly erodable, alkaline, droughty, or waterlogged (3). The other manual addresses revegetation techniques for arid and semiarid areas (4).

Wetlands Evaluation. Wetlands have become the focus of many resource issues in the United States. They are recognized as having a number of important values, including: recreation, real estate, flood control, and wildlife. It has proved very difficult to quantify these values. A recent analysis of 40 different wetland assessment techniques identified only one with considerable promise -- a technique developed by the U.S. Federal Highway Administration called "A Method for Wetland Function Value Assessment" (5). This

technique displays the functions and values of wetlands and rates the significance of each function for a specific site. The procedure still needs refinement; however, it has been successfully used to address the impact of toxic wastes on wetlands in military areas.

Wetland Restoration. Restoration procedures for coastal wetlands are now well known (6). It is often possible to reestablish marshes in areas where they have been destroyed, or to create new wetlands to compensate losses. These techniques have been applied in several areas where military construction disturbed these habitats.

MODEL LAND USE PLAN FOR TRAINING AREAS

Natural resources on training areas can be managed in a way that enhances the training mission. An approach might be selectively thinning a forest to allow better opportunity for maneuver exercises and at the same time allow residual trees to grow faster and produce more and better timber. Another approach is to restrict high risk areas to specific activities; for example, highly erodable areas may not be suited to heavy tank traf[illegible]d be used for compass or land navigation training.

A model land use plan for training areas is being deve[illegible] Benning, Georgia. This plan incorporates most of the techniques [illegible]d earlier. Ft. Benning was chosen because it has varied and abundant natural resources, and it is a major training area. The goal is to establish a procedure that will meet training needs, produce revenue or recreation from existing resources, and not deplete the resource. The plan is divided into the following tasks:

- Conduct preliminary field investigation
- Conduct statutory and regulatory review
- Identify mission land requirements
- Conduct natural resource inventories
- Determine potential demand for alternative land uses
- Determine potential land uses
- Determine management objectives
- Determine land suitability
- Prepare land allocation and management plan

Preliminary Field Investigation. The first task was a preliminary field investigation in which the availability and quality of existing databases was examined and evaluated. This included review of resource management plans and programs, identification of existing data bases, and early recognition of potential problem areas.

Statutory and Regulatory Review. Federal, state, and local laws and regulations regarding land management authorities and responsibilities were reviewed in this task. Particular attention was given to potential problems associated with nonmilitary land uses.

Mission Land Requirement. The missions and potential missions the land is required to support are now under study.

Natural Resource Inventories. Inventories of lands, land use, and associated natural resources are being conducted. Resource information will be digitized and delineated on maps. Databases are being completed for soils, forestry, and wildlife habitat.

Alternative Land Use Demands. In this task, the potential demand for non-training related activities on post lands will be evaluated. Revenue producing uses such as agriculture and forestry will receive special attention.

Potential Land Use. Land uses that are compatible with the training mission and can be supported by the existing resource base will be identified. For example, crop production may be a source of income on lands not affected by training.

Management Objectives. The goals, requirements, and objectives of the post or higher command echelons will be determined in this task. Special attention will be given to the identification of those goals and requirements that could affect land allocation and siting decisions. Examples include post activities, training requirements, cost and manpower goals, environmental objectives, and land leasing costs.

Land Suitability. Potential land uses will be compared with management objectives to determine land suitability. Suitable land uses will be identified and mapped.

Land Allocation and Management. In this final task, land allocation and management techniques will be synthesized into an overall plan. Here, training needs will be reconciled with land use and should result in a plan which meets management objectives and encourages use of the land resource in a productive and nondegrading manner.

CONCLUSION

Protection of the resources on training areas -- the vegetation, forests, soils, and wildlife -- depends on our ability to understand and manage those resources in an integrated manner. Wildlife management procedures must meet the particular demands of the situation, and vegetation restoration techniques should be established for the most difficult areas. Success in managing our training resources will largely depend on land use plans that meet training needs, resource capabilities, and management objectives.

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DUTCH HEATHLANDS AS MILITARY TRAINING AREAS AND RESEARCH FOR NATURE MANAGEMENT

by J. Wiertz
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1. INTRODUCTION

In this paper some general background information is given about Dutch heathland and about the applied research on management practices to preserve heathland in its present form. This information can be usefull during a visit at military training area in heathland.
In the Netherlands there are completely natural heathlands in the dune areas along the coast and in the transitional area between peatmoors and dryer sandy areas. Most of the Dutch heathlands areas, however, have a semi-natural character and are to be found on sandy inland areas. Only these latter we will discuss here.

Most of the heathlands in the Netherlands are dominated by ling (Calluna vulgaris) or in wet heathlands by cross-leaved heath (Erica tetralix). In a relatively small part we can still find shifting sands on rather a larger scale than usually can be found in Western Europe. About 14 000 ha of these heathlands and shifting sands are used nowadays as military training areas.
Most of the heathland soils are Pleistocene deposited sands in which a typical podzol has developed. In such a podzol you see firstly the upper layer with raw organic material, then the black-grey organic stained A_1-horizon, then the bleached sandy A_2-horizon and black and dark brown B-horizon in which the leached humus, iron and aluminium are deposited and at last the C-horizon which consists of unchanged sand.

2. HISTORY OF HEATHLAND MANAGEMENT

In early days, the heathland was used as intensively as possible for sheep grazing and as the main source for manure on arable land. Sometimes young heather was mown and used as fodder for cattle. In the daytime the sheep could graze in the open heath but during the nighttime they were

kept inside in a deep stall where they produced large amounts of dung. In order to preserve the dung and to achieve good quality, the people cut sods in the heathland. Sometimes they burned the heather before cutting sods. These sods were brought into the stall and used as a floor. The floor of such a sheep-stable contains sods mixed with sheepdung.
Usually the people took the sodsmanure out of the stall twice a year to be used as fertilizer of the arable land. Owing to this procedure some arable fields even have been raised 0.5 - 1 m.
Since about 1880 especially when mineral fertilizers became available the area of heathlands decreased strongly in the Netherlands. Most of the heath was reclaimed and is nowadays used for intensive agricultural farming often manured with 300 kg nitrate per ha per year. At present, an area of about 40 000 ha heathland is protected by law and valued as nature reserve (see table 1).

year	ha heathland
1833	900.000
1900	600.000
1938	170.000
1950	60.000
1982	40.000

Table 1. Decrease of the heathland area in the Netherlands since 1833.

Many typical and rare plants (a.o. Gentiana pneumonanthe and Drosera intermedia) as well as animals (a.o. black grouse - Tetrao tetric, sand lizard - Lacerta agilis) can still live there. Of course heathland is also apreciated for tourism and recreation purposes.
Despite the protection the heathlands have been changing drastically during the last decades. Without management or sheep grazing the heath is being invaded by trees and,especially by grasses. 25% - 50% of the Dutch heathland has changed lately into a grassy vegetation.
When there is a strong infestation of the beetle Lochmea saturalis in the heather remarkable and interesting differences can be noticed in the regeneration process mainly depending on soil characteristics.
However, when grasses constitute a minor part of the vegetation, they often can develop as dominant species. In other cases, especially where

Calluna was the only vascular plant, the infestated Calluna dies off and new seedlings are found and/or regeneration of the original Calluna heather is possible.

3. RESEARCH FOR TODAYS HEATHLAND MANAAGEMENT

What is the actual explanation of the phenomenon that formerly a regeneration occurred with heather but nowadays mostly with grasses?
The most important factors inducing the appearance of grasses are probably:

- accumulation of organic matter by lack of removal
- an extra input of atmospheric nitrogen due to increased traffic, industries and agriculture which input is estimated at about 20 kg N per ha per year, only on wet deposition
- the drainage of wet heathland for agricultural purposes.

These three possible explanations lead to the hypothesis that if a heathland is to be maintained as a dwarf-shrub vegetation organic matter and nutrients have to be removed. You can try to do this the same way as formerly: by sheep grazing, cutting sods, mowing, burning and so on. These management practices were tried out in order to remove the organic matter and nutrients. Special attention was given to the costs and benefits. An experiment with burning as management strategy in which the total amount of nitrogen, phosphate and potassium was measured before and after, showed in most cases a drastical decrease. The amount of available nutrients had not increased in these cases.
Cutting sods is of course the most radical way to remove the total amount as well as the available amount of nutrients. In experimental fields was shown that cutting sods changes a grassy vegetation again into heather. For nature mangement, especially in wet heathland where biomass production is high, cutting sods would be the most effective way to remove the upper soillayer, rich in organic matter and nutrients. The sods are brought together in big heaps, so they can be composted. These composted sods are sold and used to substitute soil in horticulture or to grow shrubs in container bags. In respect with the costs of manpower it

is nowadays necessary to construct special cutting machinery and to try to regain some money for the sods produced. Also experimental research has been started with cattle and sheep grazing as modern nature management practices in order to study the behaviour of these animals, their effect on vegetation and the possible economic return.

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EXCURSION TO THE STAKENBERG AREA ON 29 NOVEMBER:

SHORT NOTES ABOUT THIS MILITARY TRAINING HEATHLAND AREA

by H. M. Beye
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Stop 1 General view. The area covers 300 ha, owned by the municipality and hired by the Ministry of Defence. Intensive use by troops with heavy vehicles. Vehicles are only allowed on the roads. The road system meets military requirements. Road specifications: 8 m wide; 13 km/100 ha; 10,4 ha/100 ha. Elsewhere free-use areas are available.

During the Fifties and early Sixties this heathland was freely used by vehicles. Big parts were denuded. When the area was provided with a modern sandy road system, the denuded areas and superfluous roads have been removed by ploughing, leveling down and sowing with the grass species Festuca ovina. Particularly in this area the grass is substituted by heather already after some years, probably because of the poor soil.

Stop 2 Explanation of soil profile; experimental research on effects of off-road-locomotion, research on hydrological effects of sandy roads.

To carry out experiments on off-road-locomotion in a controlled way, wheeltesters have been applied with the result of which wheight, speed and percentage of slip have been adapted precisely. Besides, the performances of tires can be measured.

When the experiments have been carried out, among others soil compaction is measured with a penetrometer. Soil compaction may diminish directly the possibilities for rooting of plants. Soil compaction is also considered to change other soil properties.

Effects at long notice in the vegetation are believed to be results of alteration of soil properties and, maybe in some degree, of mechanical damage to the plants. With the help of a stereo camera system photographs are taken from 5 m height. The results of analyzing the photographs are compared with e.g. the results of soil resistance measurements.

Dense illuvial layers in the podzolic soil profiles are considered to stagnate rainwater infiltration. Assuming this, lateral water movement may occur on slopes. Construction of roads could alterate this situation. By measuring the saturated hydraulic conductivities

unexpected high flow rates of spodic horizons were noticed. However, surface runoff seemed to be considerable, which is influenced by construction of sandy roads.

Stop 3 Heathland management by cutting sods. In former times, sods ('plaggen') were cut by farmers to use in stables. This plaggen practice is still important for nature management. The sods can be useful in restoring areas that have been denuded by military vehicles. Mechanically cutting sods has to be carried out very carefully to avoid soil damage and loss of historical information in the soil.

Stop 4 Alteration of the vegetation because of off-road locomotion. A trail owing to repeated tank passes in the Fifties clearly finds expression now in a dominating grass vegetation amidst heathland. Areas that have been used less intensively by vehicles, have hardly any outward changes in the vegetation. Comparison of vegetation relevés from areas with formerly different intensities of use shows real differences nevertheless.

Stop 5 Protection of special elements. A small lake in the Stakenberg area was the first and the only object to protect in the early Fifties. This lake exists only by the presence of impermeable soil layers. Explosives damaged these layers in nearly sites, which are very dry now. Protection of individual elements is now taken over by protective measures of ecosystems and landscape according to multiple use principles, as far as military demands allow.

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